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John Brennan, Steve Ryan, Marina Ranga, Simon Broek, Niccolo Durazzi, Bregtje Kamphuis

Study on innovation in higher education: final report

Report

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European Commission

Study on Innovation in Higher Education

Executive Summary

Written by LSE Enterprise

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Executive summary

Introduction

In meeting the objectives of the Europe2020 Strategy, European institutions assigned a central role to higher education. The European Commission (EC), in subsequent communications released in 2011, 2012 and 2013, stressed the importance of education – and higher education in particular – as a key enabler of smart, sustainable and inclusive growth. This study is firmly framed within this policy context, providing primary evidence on many of the themes that recent EC communications touch upon, as far as innovation in higher education is concerned. The report aims in particular to contribute to a better understanding of recent developments affecting higher education and provide evidence of how innovation can support higher education in times of change.

The study builds on four overarching research questions.

- What are the main challenges facing higher education and driving innovation in this sector?
- What are the key differences in terms of regional and institutional contexts for achieving successful innovation in higher education for different constituencies?
- How does innovation in higher education involve key system components and how does it influence – directly and indirectly – the system functions? What are the key processes and the roles of the key stakeholders in implementing innovation?
- What are the major outcomes of innovation in higher education and what main bottlenecks and blockages exist in achieving them?

In order to gather the evidence base to answer these questions, and to shed light on selected processes of innovation in the higher education sector, desk research and seven case studies have been conducted, that fall within three interconnected themes with system-wide significance and implications for all higher education stakeholders, as follows:

Case study	Theme
Innovative approaches to teaching and learning at the Olin College of Engineering (US)	The changing landscape of teaching and learning in higher education
Macro-level blended learning at the Bavaria Virtual University (Germany)	
US- originated MOOCs (Coursera, Udacity, NovoEd)	
EU-originated MOOCs (multi- and single- institution platform providers)	
The development of Learning Analytics at Purdue University (US), University of Derby (UK), and University of Amsterdam (the Netherlands)	Technology and the student performance in higher education
The eAdvisor at Arizona State University (US)	

The internationalisation strategy of the University of Nottingham (UK) and the establishment of campuses in Asia	Globalisation and multi-campus universities

Analytical framework

The project takes an innovative approach by adopting the concept of 'innovation systems' and adapting it to higher education. The analytical construct of 'higher education innovation system' has thus been developed as a sub-set of an innovation system, concentrated particularly in higher education institutions which are in close connection with other institutional spheres, such as industry, government and non-government agencies, and the society at large. A higher education innovation system can be seen as a set of functions, components and relationships, which allow us to disaggregate the various levels of interactions among the elements of the system and analyse the unfolding of innovation in higher education, as summarised below.

Higher education innovation system		
Functions	**Components**	**Relationships**
• Education • Research • Engagement ('third mission')	• Direct and indirect actors • Institutional and individual actors	• Collaboration/conflict moderation • Substitution • Networking

Using a system approach was beneficial for two main purposes:

- It allowed the project to move beyond higher education as a broad category and rather look into single elements that compose it, being able to pinpoint why, how, and what innovation takes place and who are the actors that drive (or hinder) innovation;
- It allowed the project to take a dynamic approach by looking not only at innovation within the elements described above but also at the interaction within and among components, relationships, and functions.

Case studies

Each of the seven case studies has been filtered through the higher education innovation system approach, so that the analysis highlighted in each case study the function(s) that the initiative focuses on; the relevant actors that take part in the initiative; and the relationships that are established among the actors. The seven case studies are summarised below.

Olin College of Engineering

This case study focuses on the approach to teaching and learning adopted at Olin College of Engineering. In particular, it provides an account of the college's interdisciplinary curriculum that is built around the "Olin Triangle", which includes studies in Science and Engineering, Business & Entrepreneurship, and Arts/Humanities/Social Sciences, in collaboration with two neighbouring colleges, one specialised in Business (Babson College) and one in liberal arts (Wellesley Colleges). The aim of Olin is to produce graduates who have robust technical skills, the ability to apply engineering concepts to real problems, an interdisciplinary orientation and extensive design experience.

Bavaria Virtual University (BVU)
This case study provides an example of education-focused cooperation between state-funded universities in the German state of Bavaria. The BVU promotes and coordinates the development and implementation of tailor-made online course offerings at Bavarian universities for students (for free) and others (low fee). Online courses are developed according to "blended learning at macro level", meaning that the course (micro-level) needs to be completely online so that it can be used in the study programmes of all universities. However, the BVU does not provide a complete online study programme: study programmes (macro-level) are therefore blended, as parts are traditional face-to-face courses and others are online courses.

US-originated MOOCs
The case study focuses on Coursera, Udacity and NovoEd, all venture capital-backed education companies spun off from Stanford University offering online learning at low- or no- cost to thousands of students across the globe through partnerships with several universities. All are very young companies (Udacity was launched in January 2012, Coursera in April 2012 and NovoED in April 2013) and are founded by Stanford professors. All companies have a close connection with Stanford and the entrepreneurial and venture capital community of Silicon Valley, which had a key role in their creation and dynamic growth. The companies share a common belief in their role to bring accessible, affordable, engaging, and effective higher education to the world.

EU-originated MOOCs
The case study examines three initiatives at different stages of development: FutureLearn, OpenHPI and Leuphana. FutureLearn is a consortium-based MOOC provider based on prestigious UK and other universities partnering with world-known UK institutions (British Council, British Library and British Museum) and the UK government. It is led by a not for-profit company owned by the UK's Open University, and has been formed as a UK response to large US MOOC providers, particularly Coursera, edX and Udacity. It has high-level political support from the UK Government. By contrast, the two German cases considered are niche providers with strong regional public sector and private sector support. OpenHPI is a development of Hasso Plattner Institute (HPI) based at the University of Potsdam in Germany. Leuphana is a public university in Northern Germany and it utilised the brand of the Leuphana Digital School as a platform for its online education In January 2013.

Learning Analytics at Purdue University, the University of Derby, and the University of Amsterdam
This case study examines innovative approaches to the use of student data to inform decision-making by the use of Learning Analytics across three universities. The concrete examples are:

- Purdue University (US) has implemented Course Signals to increase student success in the classroom. Purdue University's Course Signals application detects early warning signs and provides intervention to students who may not be performing to the best of their abilities before they reach a critical point. Course Signals is easy to use, it provides real-time, frequent and ongoing feedback.

Furthermore, interventions start early - as early as the second week of class.

- The University of Derby (UK) explored the strategies to improve student enhancement processes by addressing key questions such as: (i) What is actually happening to students, how can we find out?; (ii) What are the touch points between students and the institution?; (iii) What are the institutional "digital footprints" of the students?; and (iv) What really matters to students?
- The Dutch University of Amsterdam (UvA) and the Free University of Amsterdam (VU) received a fund from SURF to conduct a pilot study on user requirements for LA. It looked into ways to use data to make visualisations to inform teachers on (i) the use of e-learning material by students; (ii) the order in which the learning material is used; and (iii) whether there is a relationship between the number of materials used and the study results.

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The e-Advisor is ASU's electronic advising and degree tracking system. It uses modern technology and data analytics to help students find majors that best fit their interests and thus ensure they have the highest likelihood to graduate. The key objectives of the initiative are to increase the student retention and graduation rate, provide quality education at affordable costs to an ever increasing number of students.

The internationalisation strategy of the University of Nottingham (UK) and the establishment of campuses in Asia
This case study analyses the internationalisation strategy of the University of Nottingham which started with plans to set up two international campuses in Malaysia and China, originating in the 1990s. This innovation is seen as part of deeper and wider institutional processes: the initiatives aimed not only to make Nottingham a global university, but to transform its identity, mission and ways of working from deeply conservative to vibrant, visionary and imaginative. The initiative is seen as "deliberatively disruptive". The overall objective of establishing the two Asian campuses, in Semenyih, Malaysia in 2000, and Ningbo, China in 2004, was to create a different identity and stature for the University than could be won in the UK alone; to progressively embed an attitude of innovation and an international outlook throughout the University.

Main findings

The findings of the study are structured around the four overarching research questions and closely reflect the analytical framework adopted as backbone of the study. The main findings are summarised below:

Main challenges for higher education driving innovation

Three main challenges that the higher education sector faces across the globe and that are also driving innovation in this sector have been identified: (i) pressures from globalisation; (ii) changing supply of and demand for higher education; and (iii) changes in higher education funding. These various challenges determine the development and implementation of various innovative practices to address them. The same challenge may trigger the introduction of different innovative practices in different institutional contexts, while the same innovative practice may be simultaneously driven by more than one challenge.

Contexts for successful innovation

Successful innovative practices build on an interplay between national/regional and institutional factors. The prominence of one or another type of factor varies subject to various features, such as scope of the initiative and level of autonomy of an institution. Regarding the former, the broader the scope, the higher the influence of national/regional factors; the more limited the scope, the higher the influence of institutional factors. Regarding the latter, more autonomous higher education institutions, having more control over their financial resources and allocation of these resources to their functions, tend to develop more bottom-up practices. The direct impact of these types of innovations may be more immediate, but also more limited, often confined to the boundaries of the innovating institution. On the other hand, less autonomous higher education institutions tend to have a more top-down, state-driven approach to innovation. This does not make them less innovative, but comes to support wider-ranging relationships and processes across the higher education system and longer timescales for implementation, ensuring a longer-term and larger impact beyond institutional boundaries.

Components, functions and relationships in a higher education innovation system

The development and implementation of innovations in higher education systems have an impact on all the systems elements: components, relationships and functions. At the components level, a wide range of direct and indirect, individual and institutional actors are influenced by these innovations. At the relationships level, the most important effects are due to cooperation, networking and increased mobility, which may alter traditional relationships among actors or introduce new ones. At the functions level, the most significant impact is observed on the education function, and a more limited, but growing impact is observed on the research and engagement functions. This may be seen just as a manifestation of the early stage at which many of the innovative practices examined find themselves, rather than an effect of a minor importance of the innovation. Therefore, the impact of some innovation practices on other system functions, such as research and engagement, is likely to intensify and become more visible over time, as the innovation matures and diffuses more broadly into the higher education innovation system. Three dynamics appear to be most significant within an innovative higher education system:

- As innovation diffuses within the higher education system and touches every element of a higher education institution, the innovation process needs to be better managed. While management methodologies are taught in many universities, university managers are not trained for this, and in most cases they are promoted academics;
- There is a reciprocal nature of change within an innovative higher education system: the system elements (components, relationships and functions) have an impact on the success of the innovation, while the success of the innovation induces further changes in the system elements. A spiral of change is thus created within the higher education system to make it more responsive to environmental changes;
- The change induced in a higher education innovation system by the innovative practices examined in the study is not of a radical nature, but is rather slow and incremental. Many innovation practices do not radically modify the traditional Higher education institutions' functions; rather, they provide new ways of doing traditional things that that respond more efficiently to changing requirements in higher education.

Outcomes and blockages

Four main outcomes of innovation in higher education emerge: (i) the vision behind and the use of new technologies represent enablers of innovative practices, rather than innovations per se; (ii) the use of new technologies appears to be a facilitator of the transition from a department-centred vision to a student-centred vision of education; (iii) innovation often stimulates an accelerated development of partnerships between Higher education institutions and other organisations, especially businesses; (iv) innovations in higher education illustrate well two general key aspects of the innovation process: 'doing new things' and 'doing existing things better'.

The blockages for innovation can be found both at the institutional -level, such as the lack of institutional support for innovative practices and at national/regional, for example influenced by different degrees of autonomy of higher education institutions. Regulatory frameworks are also a crucial potential blockage to some innovative practices. Notwithstanding these blockages, innovative practices do show the potential for delivering high-quality and equitable outcomes, in terms of widening access to higher education, granting students a more central role within the system, and providing potential pathways to cope with the financial pressures that affect the system.

Policy recommendations

Policy recommendations are clustered around the three central themes identified through the study and focus on two particular target groups, higher education institutions and policy-makers.

Policy recommendations related to the changing landscape of teaching and learning in higher education

Higher education institutions should consider the need to:

- Nurture an institutional culture to innovation that enhances creativity, creates awareness of the benefits resulting from the implementation of the innovation, stimulates openness to innovation and minimises resistance to change
- Consider incentives and rewards for members of staff (including but not limited to academics) who engage in innovative practices
- Engage faculty members in exploiting the potential of new learning technologies
- Consider the use of cross-institutional collaboration to improve student choice and quality (and possibly cut costs)
- Put in place adequate measures for skills development of teaching staff and also for greater collaboration in performing their teaching duties
- Review existing organisational boundaries and linkages

Policy-makers should consider the need to:

- Establish a clear regulatory framework that addresses blockages that some developments in online learning are faced with today, including: inappropriate quality assurance mechanisms, the lack of credit recognition processes and intellectual property right regulations

Policy recommendations related to technology and student performance in higher education

Higher education institutions should consider the need to:

- Identify the (diverse) needs and circumstances of the learners;
- Ensure learner access to relevant technologies and possession of necessary skills to gain maximum benefits from them;
- Recognise that the successful introduction of learning analytics will be dependent not only on the choice of technology but on making the institutional changes necessary so that teachers, IT staff and administrators work effectively together to support students.
- Provide appropriate processes, tools and support activities so that Faculty are able to fully utilise the rich data generated through analytics to enable them to respond to individual student needs and to further develop their teaching.
- Clarify the roles of the different actors (within and beyond the institution) involved in meeting these needs;
- Ensure a collective understanding of the different roles/responsibilities and the relationships between them
- Ensure clear lines of management responsibility and information requirements to assess performance
- Build supportive relationships and trust between the relevant actors (students, academic staff, support staff, IT staff, managers and, where applicable, employers)

Policy-makers should consider the need to:

- Clarify the funding implications, intended outcomes and timescales for the innovation
- Collect and analyse feedback information (from learners, institutions, employers etc) on performance and impact, and inform all relevant actors
- Identify any unintended consequences of the innovation (e.g. for other functions, for widening participation or labour market linkages)

Policy recommendations related to globalisation and internationalisation strategies

Higher education institutions should consider the need to:

- Balance commercial, educational and reputational considerations in formulating overall international strategy
- Address a range of interconnected factors such as student mobility (inward and outward), student placements, qualification recognition, funding implications, curriculum and pedagogic implications, and labour market linkages
- Consider the needs of different actors including home and international students, academic and support staff, quality assurance agencies, employers and sponsoring bodies
- Engage 'home' staff and to build relationships between staff located at the different campuses
- Establish how much to 'export' from the home institution and how much to build

to reflect local contextual factors at different campuses
- Establish how much to ‘import’ from the international activities to reshape the home institution
- Satisfy different national regulatory and quality assurance regimes

Policy-makers should consider the need to:
- Provide support for inward and outward mobility of students

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Contents

Authors and Acknowledgements

Correspondence
Niccolo Durazzi
LSE Enterprise
n.durazzi@lse.ac.uk

Report authors
John Brennan
Simon Broek
Niccolo Durazzi
Bregtje Kamphuis
Marina Ranga
Steve Ryan

Case study authors
Simon Broek
Ming Cheng
Chris Duke
Fumi Kitigawa
Pamela Marcucci
Michael Osborne
Marina Ranga

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Three main challenges that the higher education sector faces across the globe and that are also driving innovation in this sector have been identified: (i) pressures from globalisation; (ii) changing supply of and demand for higher education; and (iii) changes in higher education funding. These various challenges determine the development and implementation of various innovative practices to address them. The same challenge may trigger the introduction of different innovative practices in different institutional contexts, while the same innovative practice may be simultaneously driven by more than one challenge.

Contexts for successful innovation

Successful innovative practices build on an interplay between national/regional and institutional factors. The prominence of one or another type of factor varies subject to various features, such as scope of the initiative and level of autonomy of an institution. Regarding the former, the broader the scope, the higher the influence of national/regional factors; the more limited the scope, the higher the influence of institutional factors. Regarding the latter, more autonomous higher education institutions, having more control over their financial resources and allocation of these resources to their functions, tend to develop more bottom-up practices. The direct impact of these types of innovations may be more immediate, but also more limited, often confined to the boundaries of the innovating institution. On the other hand, less autonomous higher education institutions tend to have a more top-down, state-driven approach to innovation. This does not make them less innovative, but comes to support wider-ranging relationships and processes across the higher education system and longer timescales for implementation, ensuring a longer-term and larger impact beyond institutional boundaries.

Components, functions and relationships in a higher education innovation system

The development and implementation of innovations in higher education systems have an impact on all the systems elements: components, relationships and functions. At the components level, a wide range of direct and indirect, individual and institutional actors are influenced by these innovations. At the relationships level, the most important effects are due to cooperation, networking and increased mobility, which may alter traditional relationships among actors or introduce new ones. At the functions level, the most significant impact is observed on the education function, and a more limited, but growing impact is observed on the research and engagement functions. This may be seen just as a manifestation of the early stage at which many of the innovative practices examined find themselves, rather than an effect of a minor importance of the innovation. Therefore, the impact of some innovation practices on other system functions, such as research and engagement, is likely to intensify and become more visible over time, as the innovation matures and diffuses more broadly into the higher education innovation system. Three dynamics appear to be most significant within an innovative higher education system:

- As innovation diffuses within the higher education system and touches every element of a higher education institution, the innovation process needs to be better managed. While management methodologies are taught in many universities, university managers are not trained for this, and in most cases they are promoted academics;
- There is a reciprocal nature of change within an innovative higher education system: the system elements (components, relationships and functions) have an impact on the success of the innovation, while the success of the innovation induces further changes in the system elements. A spiral of change is thus created within the higher education system to make it more responsive to environmental changes;
- The change induced in a higher education innovation system by the innovative practices examined in the study is not of a radical nature, but is rather slow and incremental. Many innovation practices do not radically modify the traditional Higher education institutions' functions; rather, they provide new ways of doing traditional things that that respond more efficiently to changing requirements in higher education.

Outcomes and blockages

Four main outcomes of innovation in higher education emerge: (i) the vision behind and the use of new technologies represent enablers of innovative practices, rather than innovations per se; (ii) the use of new technologies appears to be a facilitator of the transition from a department-centred vision to a student-centred vision of education; (iii) innovation often stimulates an accelerated development of partnerships between Higher education institutions and other organisations, especially businesses; (iv) innovations in higher education illustrate well two general key aspects of the innovation process: 'doing new things' and 'doing existing things better'.

The blockages for innovation can be found both at the institutional -level, such as the lack of institutional support for innovative practices and at national/regional, for example influenced by different degrees of autonomy of higher education institutions. Regulatory frameworks are also a crucial potential blockage to some innovative practices. Notwithstanding these blockages, innovative practices do show the potential for delivering high-quality and equitable outcomes, in terms of widening access to higher education, granting students a more central role within the system, and providing potential pathways to cope with the financial pressures that affect the system.

Policy recommendations
Policy recommendations are clustered around the three central themes identified through the study and focus on two particular target groups, higher education institutions and policy-makers.

Policy recommendations related to the changing landscape of teaching and learning in higher education

Higher education institutions should consider the need to:

- Nurture an institutional culture to innovation that enhances creativity, creates awareness of the benefits resulting from the implementation of the innovation, stimulates openness to innovation and minimises resistance to change
- Consider incentives and rewards for members of staff (including but not limited to academics) who engage in innovative practices
- Engage faculty members in exploiting the potential of new learning technologies
- Consider the use of cross-institutional collaboration to improve student choice and quality (and possibly cut costs)
- Put in place adequate measures for skills development of teaching staff and also for greater collaboration in performing their teaching duties
- Review existing organisational boundaries and linkages

Policy-makers should consider the need to:

- Establish a clear regulatory framework that addresses blockages that some developments in online learning are faced with today, including: inappropriate quality assurance mechanisms, the lack of credit recognition processes and intellectual property right regulations

Policy recommendations related to technology and student performance in higher education

Higher education institutions should consider the need to:

- Identify the (diverse) needs and circumstances of the learners;
- Ensure learner access to relevant technologies and possession of necessary skills to gain maximum benefits from them;
- Recognise that the successful introduction of learning analytics will be dependent not only on the choice of technology but on making the institutional changes necessary so that teachers, IT staff and administrators work effectively together to support students.
- Provide appropriate processes, tools and support activities so that Faculty are able to fully utilise the rich data generated through analytics to enable them to respond to individual student needs and to further develop their teaching.
- Clarify the roles of the different actors (within and beyond the institution) involved in meeting these needs;
- Ensure a collective understanding of the different roles/responsibilities and the relationships between them
- Ensure clear lines of management responsibility and information requirements to assess performance
- Build supportive relationships and trust between the relevant actors (students, academic staff, support staff, IT staff, managers and, where applicable, employers)

Policy-makers should consider the need to:

- Clarify the funding implications, intended outcomes and timescales for the innovation
- Collect and analyse feedback information (from learners, institutions, employers etc) on performance and impact, and inform all relevant actors
- Identify any unintended consequences of the innovation (e.g. for other functions, for widening participation or labour market linkages)

Policy recommendations related to globalisation and internationalisation strategies

Higher education institutions should consider the need to:

- Balance commercial, educational and reputational considerations in formulating overall international strategy
- Address a range of interconnected factors such as student mobility (inward and outward), student placements, qualification recognition, funding implications, curriculum and pedagogic implications, and labour market linkages
- Consider the needs of different actors including home and international students, academic and support staff, quality assurance agencies, employers and sponsoring bodies
- Engage ‘home’ staff and to build relationships between staff located at the different campuses
- Establish how much to ‘export’ from the home institution and how much to build to reflect local contextual factors at different campuses
- Establish how much to ‘import’ from the international activities to reshape the home institution
- Satisfy different national regulatory and quality assurance regimes

Policy-makers should consider the need to:

- Provide support for inward and outward mobility of students

Résumé

Introduction

Pour atteindre les objectifs de la stratégie Europe 2020, les institutions européennes ont attribué un rôle central à l'enseignement supérieur. Dans des communications ultérieures publiées en 2011, 2012 et 2013, la Commission européenne (CE) a souligné l'importance de l'éducation – et de l'enseignement supérieur en particulier – comme facteur clé de la croissance intelligente, durable et inclusive. Cette étude s'inscrit fermement dans ce contexte politique, fournissant des preuves primaires sur la plupart des thèmes touchant à l'innovation dans l'enseignement supérieur abordés dans les récentes communications de la CE. Le rapport vise en particulier à contribuer à une meilleure compréhension des évolutions récentes observées dans le secteur de l'enseignement supérieur et à fournir des preuves de la façon dont l'innovation peut soutenir l'enseignement supérieur dans une ère de changement.

L'étude s'articule autour de quatre questions générales de recherche.

- Quels sont les principaux défis de l'enseignement supérieur et de la promotion de l'innovation dans ce secteur ?
- Quelles sont les principales différences en termes de contextes régionaux et institutionnels pour la réalisation d'une innovation réussie dans l'enseignement supérieur pour les différents groupes d'intérêt ?
- Dans quelle mesure l'innovation dans l'enseignement supérieur implique-t-elle les principaux composants du système et comment influence-t-elle – directement et indirectement – les fonctions du système ? Quels sont les processus clés et les rôles des acteurs clés dans la mise en œuvre de l'innovation ?
- Quels sont les principaux résultats de l'innovation dans l'enseignement supérieur et quels principaux goulets d'étranglement et blocages se dressent sur le chemin pour l'atteindre ?

Afin de recueillir des données probantes pour répondre à ces questions et, pour faire la lumière sur les processus d'innovation sélectionnés dans le secteur de l'enseignement supérieur, une recherche documentaire et sept études de cas ont été réalisées. Elles couvrent trois thèmes étroitement liés ayant une signification et des implications à l'échelle du système pour toutes les parties prenantes de l'enseignement supérieur, comme suit :

Étude de cas	Thème
Des approches novatrices à l'enseignement et à l'apprentissage au Olin College of Engineering (États-Unis)	Le paysage changeant de l'enseignement et de l'apprentissage dans l'enseignement supérieur
L'apprentissage mixte au niveau général à la Bavaria Virtual University (Allemagne)	
Les MOOC proposés depuis les États-Unis (Coursera, Udacity, NovoEd)	
Les MOOC proposés depuis l'UE (fournisseurs de plateforme à des institutions uniques et multiples)	

Le développement de l'analyse de l'apprentissage à l'université Purdue (États-Unis), à l'université de Derby (Royaume-Uni) et à l'université d'Amsterdam (Pays-Bas)	La technologie et les performances des étudiants dans l'enseignement supérieur
L'eAdvisor à l'Arizona State University (États-Unis)	
La stratégie d'internationalisation de l'université de Nottingham (Royaume-Uni) et la mise en place de campus en Asie	La mondialisation et les universités multi-campus

Cadre analytique

Le projet s'engage dans une approche novatrice en adoptant le concept de « systèmes d'innovation » qu'il adapte à l'enseignement supérieur. La structure analytique du « système d'innovation dans l'enseignement supérieur » a donc été conçue comme un sous-ensemble d'un système d'innovation, concentré en particulier dans les établissements d'enseignement supérieur en étroite relation avec d'autres domaines institutionnels, tels que l'industrie, les organismes gouvernementaux et non gouvernementaux et la société en général. Un système d'innovation dans l'enseignement supérieur peut être perçu comme un ensemble de fonctions, de composantes et de relations, qui nous permettent de ventiler les différents niveaux d'interactions entre les éléments du système et d'analyser le déroulement de l'innovation dans l'enseignement supérieur, tel que résumé ci-dessous.

Système d'innovation dans l'enseignement supérieur		
Fonctions	**Composantes**	**Relations**
• Éducation • Recherche • Engagement (« troisième mission »)	• Acteurs directs et indirects • Acteurs institutionnels et individuels	• Collaboration/modération de conflits • Substitution • Réseau

Le recours à une approche de système s'est avéré bénéfique pour deux raisons principales :

- il a permis au projet d'aller au-delà de l'enseignement supérieur en tant que vaste catégorie et de se pencher plutôt sur des éléments individuels qui le composent, en étant en mesure de déterminer pourquoi, comment et quelle innovation a lieu mais également les acteurs qui l'animent (ou l'entravent) ;
- il a permis au projet d'adopter une approche dynamique en examinant non seulement l'innovation dans les éléments décrits ci-dessus, mais également l'interaction au sein et entre les composantes, les relations et les fonctions.

Études de cas

Chacune des sept études de cas a été filtrée à l'aide de l'approche du système d'innovation dans l'enseignement supérieur. En conséquence, l'analyse a mis en évidence dans chaque étude de cas, la ou les fonction(s) sur la ou lesquelles l'initiative met l'accent : les acteurs concernés qui participent à l'initiative et les relations nouées entre les acteurs. Les sept études de cas sont résumées ci-dessous.

Olin College of Engineering

Cette étude de cas porte sur l'approche de l'enseignement et de l'apprentissage adoptée à Olin College of Engineering. De manière spécifique, elle présente le programme interdisciplinaire de l'université qui est construit autour du « Olin Triangle », qui comprend les études en sciences et en ingénierie, les entreprises et l'entreprenariat et les arts, sciences humaines et sociales, en collaboration avec deux universités voisines, une spécialisée en entreprises (Babson College) et une en arts libéraux (Wellesley Colleges). Le but d'Olin est de produire des diplômés dotés de compétences techniques solides, de la capacité d'appliquer les concepts d'ingénierie à des problèmes réels, d'une orientation interdisciplinaire et d'une vaste expérience de la conception.

Bavaria Virtual University (BVU)

Cette étude de cas illustre la coopération axée sur l'éducation entre les universités financées par l'État dans le Land allemand de Bavière. La BVU favorise et coordonne l'élaboration et la mise en œuvre de l'offre de cours sur mesure en ligne dans les universités bavaroises à l'intention des étudiants (sans frais) et d'autres (à coût réduit). Les cours en ligne sont développés selon l'« apprentissage mixte au niveau général », ce qui signifie que le cours (au niveau spécialisé) doit être entièrement en ligne de sorte qu'il puisse être utilisé dans les programmes d'études de toutes les universités. Cependant, la BVU ne fournit pas un programme d'études complet en ligne : les programmes d'études (au niveau général) sont donc mixtes, avec des parties des cours traditionnels en face-à-face et d'autres cours en ligne.

MOOC proposés depuis les États-Unis

L'étude de cas porte sur Coursera, Udacity et NovoEd, toutes les entreprises d'éducation financées par du capital-risque issues d'un essaimage de Stanford University offrant l'apprentissage en ligne à faible coût ou sans frais à des milliers d'étudiants à travers le monde grâce à des partenariats avec plusieurs universités. Il s'agit toutes de très jeunes entreprises (Udacity a été lancé en janvier 2012, Coursera en avril 2012 et NovoED en avril 2013) et ont été fondées par des professeurs de Stanford. Toutes les entreprises ont un lien étroit avec Stanford et la communauté entrepreneuriale et du capital-risque de la Silicon Valley, qui a joué un rôle clé dans la création et la croissance dynamique. Les entreprises partagent une croyance commune dans leur rôle d'offrir au monde un enseignement supérieur accessible, abordable, attrayant et efficace.

MOOC proposés depuis l'UE

L'étude de cas porte sur trois initiatives à différents stades de développement : FutureLearn, OpenHPI et Leuphana. FutureLearn est un fournisseur de MOOC en consortium basé dans des universités prestigieuses de Grande-Bretagne et d'autres en partenariat avec des institutions britanniques de renommée mondiale (British Council, British Library et British Museum) et le gouvernement du Royaume-Uni. Il est dirigé par une société à but non lucratif appartenant à l'Open University du Royaume-Uni et a été créé comme une réponse du Royaume-Uni aux grands fournisseurs de MOOC des États-Unis, en particulier Coursera, edX et Udacity. Il bénéficie du soutien politique de haut niveau du gouvernement britannique. En revanche, les deux cas allemands étudiés sont des fournisseurs de niche bénéficiant d'un fort soutien du secteur public et du secteur privé régionaux. OpenHPI est un développement de Hasso Plattner Institute (HPI), basé à l'université de Potsdam en Allemagne. Leuphana est une université publique du nord de l'Allemagne et il a utilisé la marque de la Leuphana Digital School comme plateforme pour son enseignement en ligne en janvier 2013.

L'analyse de l'apprentissage à Purdue University, University of Derby et University of Amsterdam

Cette étude de cas examine les approches novatrices de l'utilisation de données sur les étudiants pour éclairer la prise de décisions par l'utilisation de l'analyse d'apprentissage dans les trois universités. Les exemples concrets sont les suivants :

- Purdue University (États-Unis) a mis en place des signaux de cours pour augmenter la réussite des étudiants dans la salle de classe. Les signaux de cours de Purdue University détectent les signes d'alerte précoce et fournissent une intervention aux étudiants qui n'arrivent pas à exploiter au mieux leurs capacités avant de se retrouver dans une situation critique. Les signaux de cours sont facile à utiliser et fournissent en temps réel une rétroaction fréquente et continue. En outre, les interventions commencent tôt - dès la deuxième semaine de cours.
- La University of Derby (Royaume-Uni) a étudié les stratégies visant à renforcer les processus d'amélioration des étudiants en abordant des questions clés telles que : (i) Qu'est-ce qui se passe réellement chez les étudiants, comment pouvons-nous savoir ? (ii) Quels sont les points de contact entre les étudiants et l'institution ? (iii) Quelles sont les « empreintes numériques » institutionnelles des étudiants ? Et (iv) qu'est-ce qui compte vraiment pour les étudiants ?
- La Dutch University of Amsterdam (UvA) et la Free University of Amsterdam (VU) ont bénéficié d'un fonds de SURF pour mener une étude pilote sur les besoins des utilisateurs pour LA. Elle a passé en revue les façons d'utiliser les données pour concevoir des visualisations destinées à informer les enseignants sur (i) l'utilisation du matériel didactique par les étudiants, (ii) l'ordre dans lequel le matériel didactique est utilisé, et (iii) s'il existe un lien entre le nombre de matériels utilisés et les résultats de l'étude.

L'eAdvisor de l'Arizona State University (ASU)

L'eAdvisor est le système électronique de conseil et de suivi des diplômes de l'ASU. Il utilise les technologies modernes et l'analyse de données pour aider les étudiants à choisir les spécialisations qui correspondent le mieux à leurs intérêts et ainsi s'assurer qu'ils ont la plus forte probabilité d'obtenir leur diplôme. Les principaux objectifs de l'initiative sont : accroître la persévérance estudiantine et le taux d'obtention du diplôme, dispenser un enseignement de qualité à des coûts abordables à un nombre toujours croissant d'étudiants.

La stratégie d'internationalisation de l'université de Nottingham (Royaume-Uni) et la mise en place de campus en Asie

Cette étude de cas analyse la stratégie d'internationalisation de l'université de Nottingham qui a entamé la mise en œuvre de plans visant à créer deux campus internationaux en Malaisie et en Chine, depuis les années 1990. Cette innovation est considérée comme faisant partie de processus institutionnels plus profonds et plus vastes : les initiatives visaient non seulement à faire de l'université de Nottingham une université mondiale, mais de transformer son identité, sa mission et ses méthodes de travail profondément conservatrices en vue d'en faire une institution dynamique, visionnaire et imaginative. L'initiative est considérée comme « délibérément perturbatrice ». L'objectif global de l'établissement des deux campus de l'Asie, à Semenyih en Malaisie en 2000 et à Ningbo en Chine en 2004, était de créer une identité et une stature différentes de l'université qu'il est impossible d'obtenir au Royaume-Uni uniquement. Il s'agit d'intégrer progressivement une attitude d'innovation et une perspective internationale dans toute l'université.

Principales conclusions

Les résultats de l'étude s'articulent autour des quatre questions générales de recherche et reflètent étroitement le cadre analytique adopté comme épine dorsale de l'étude. Les principaux résultats sont résumés ci-dessous :

Principaux défis auxquels est confronté l'enseignement supérieur dans la conduite de l'innovation

Trois principaux défis auxquels le secteur de l'enseignement supérieur est confronté à travers le monde et qui sont également des vecteurs d'innovation dans ce secteur ont été identifiés : (i) les pressions de la mondialisation, (ii) l'évolution de l'offre et de la demande pour l'enseignement supérieur et (iii) les changements dans le financement de l'enseignement supérieur. Ces différents défis déterminent le développement et la mise en œuvre de diverses pratiques innovantes pour y faire face. Le même défi peut déclencher la mise en place de diverses pratiques innovantes dans différents contextes institutionnels, tandis que la même pratique innovante peut être entraînée simultanément par plus d'un défi.

Contextes d'innovation réussie

Les pratiques innovantes réussies s'appuient sur une interaction entre les facteurs nationaux/régionaux et institutionnels. L'importance de l'un ou l'autre type de facteur varie selon diverses caractéristiques, telles que la portée de l'initiative et le niveau d'autonomie d'une institution. En ce qui concerne le premier, plus le champ d'application est large, plus l'influence de facteurs nationaux/régionaux se fait ressentir. Plus le champ d'application est limité, plus l'influence des facteurs institutionnels se fait ressentir. En ce qui concerne le dernier, des établissements d'enseignement supérieur jouissant d'une plus grande autonomie, disposant de plus de contrôle sur leurs ressources financières et d'allocation de ces ressources à leurs fonctions, ont tendance à développer des pratiques plus ascendantes. L'impact direct de ces types d'innovations peut être plus immédiat, mais également plus limité, souvent confiné aux limites de l'institution innovante. D'autre part, les institutions d'enseignement supérieur moins autonomes ont tendance à avoir une approche descendante de l'innovation menée par l'État. Cela ne les rend pas moins novatrices, mais vient à l'appui d'un champ d'application plus large des relations et des processus au sein du système d'enseignement supérieur et des échéances plus longues pour la mise en œuvre, en assurant un impact à plus long terme et plus grand au-delà des frontières institutionnelles.

Composantes, fonctions et relations dans un système d'innovation dans l'enseignement supérieur

Le développement et la mise en œuvre des innovations dans les systèmes d'enseignement supérieur ont un impact sur tous les éléments des systèmes : les composantes, les relations et les fonctions. Au niveau des composantes, un large éventail d'acteurs directs et indirects, particuliers et institutionnels, sont influencés par ces innovations. Au niveau des relations, les effets les plus importants sont dus à la coopération, la mise en réseau et la mobilité accrue, ce qui peut modifier les relations traditionnelles entre les acteurs ou en introduire de nouvelles. Au niveau des fonctions, l'impact le plus important est observé sur la fonction de l'éducation et un impact plus limité, mais croissant, est observé sur les fonctions de recherche et d'engagement. Cela peut être considéré comme une manifestation de la première phase au cours de laquelle un grand nombre de pratiques innovantes examinées se retrouvent, plutôt qu'un effet d'importance mineure de l'innovation. Par conséquent, l'impact de certaines pratiques d'innovation sur les autres fonctions du système, telles que la recherche et l'engagement, est susceptible de s'intensifier et de devenir plus visible au fil du temps, à mesure que l'innovation se développe et se diffuse plus largement dans le système d'innovation dans l'enseignement supérieur. Trois dynamiques semblent être les plus importantes dans un système d'innovation dans l'enseignement supérieur :

- À mesure que l'innovation se diffuse dans le système d'enseignement supérieur et touche chaque élément d'un établissement d'enseignement supérieur, le processus d'innovation doit être mieux géré. Bien que les méthodes de gestion sont enseignées dans de nombreuses universités, les gestionnaires de l'université ne sont pas formés pour cela et, dans la plupart des cas, ils sont promus universitaires ;
- Il existe un caractère réciproque de changement au sein d'un système d'enseignement supérieur innovant : les éléments du système (composantes, relations et fonctions) ont un impact sur la réussite de l'innovation, tandis que la réussite de l'innovation induit d'autres changements dans les éléments du système. Une spirale de changement est ainsi créée au sein du système de l'enseignement supérieur pour le rendre plus sensible aux mutations de l'environnement ;
- Le changement induit dans un système d'innovation dans l'enseignement supérieur par les pratiques novatrices examinées dans l'étude n'est pas radical par nature, mais plutôt lent et progressif. Beaucoup de pratiques innovantes ne modifient pas radicalement les fonctions traditionnelles des établissements d'enseignement supérieur, mais elles offrent plutôt de nouvelles façons de faire les choses de manière traditionnelle qui répondent plus efficacement à l'évolution des besoins dans l'enseignement supérieur.

Résultats et blocages

Quatre principaux résultats de l'innovation dans l'enseignement supérieur se dégagent : (i) la vision sous-jacente et l'utilisation des nouvelles technologies représentent des facilitateurs de pratiques innovantes, plutôt que les innovations en elles-mêmes, (ii) l'utilisation des nouvelles technologies semble être un facilitateur de la transition d'une vision centrée sur le département vers une vision centrée sur l'étudiant, (iii) l'innovation stimule souvent un développement accéléré des partenariats entre les établissements d'enseignement supérieur et d'autres organisations, en particulier les entreprises, (iv) les innovations dans l'enseignement supérieur illustrent ainsi deux aspects principaux généraux du processus d'innovation : « faire de nouvelles choses » et « mieux faire les choses existantes ».

Les blocages à l'innovation peuvent être trouvés à la fois au niveau institutionnel, notamment le manque de soutien institutionnel pour les pratiques innovantes et au niveau national/régional, par exemple sous l'influence de différents degrés d'autonomie des établissements d'enseignement supérieur. Les cadres réglementaires représentent également un blocage potentiel crucial pour certaines pratiques innovantes. Malgré ces blocages, les pratiques innovantes affichent effectivement le potentiel pour obtenir des résultats de haute qualité et équitables, en termes d'élargissement de l'accès à l'enseignement supérieur, d'octroi aux étudiants d'un rôle plus central au sein du système et de fourniture des voies possibles pour faire face aux pressions financières qui affectent le système.

Recommandations de politique

Les recommandations de politique sont regroupées autour de trois thèmes centraux identifiés par l'étude et l'accent sur deux groupes cibles particuliers : les établissements d'enseignement supérieur et les décideurs.

Recommandations de politique relatives à l'évolution du paysage de l'enseignement et à l'apprentissage dans l'enseignement supérieur

Les établissements d'enseignement supérieur devraient envisager la nécessité de :

- Favoriser une culture institutionnelle de l'innovation qui favorise la créativité, sensibilise aux avantages résultant de la mise en œuvre de l'innovation, stimule l'ouverture à l'innovation et réduit la résistance au changement ;
- Envisager des mesures incitatives et des récompenses pour les membres du personnel (y compris, notamment, à des universitaires) qui se livrent à des pratiques innovantes ;
- Engager les membres du corps professoral à exploiter le potentiel des nouvelles technologies d'apprentissage ;
- Envisager l'utilisation de la collaboration inter-institutionnelle pour améliorer le choix offert à l'étudiant et la qualité (et éventuellement réduire les coûts) ;
- Mettre en place des mesures adéquates pour le développement des compétences du personnel enseignant et également pour une plus grande collaboration dans l'accomplissement de leurs tâches d'enseignement ;
- Réviser les limites et liens organisationnels existants.

Les décideurs politiques devraient envisager la nécessité de :

- Mettre en place un cadre réglementaire clair visant à lever les blocages auxquels certains développements dans l'apprentissage en ligne sont confrontés aujourd'hui, y compris : les mécanismes d'assurance qualité inappropriés, l'absence de processus de reconnaissance de crédit et de règlementation sur les droits de propriété intellectuelle.

Les recommandations de politique liées à la technologie et à la performance des étudiants dans l'enseignement supérieur

Les établissements d'enseignement supérieur devraient envisager la nécessité de :

- Identifier les besoins (divers) et les conditions des apprenants ;
- Assurer l'accès des apprenants aux technologies pertinentes et la possession des compétences nécessaires pour en tirer le maximum d'avantages ;
- Reconnaître que l'introduction réussie de l'analyse d'apprentissage dépendra non seulement du choix de la technologie, mais de l'engagement des changements institutionnels nécessaires afin que les enseignants, le personnel informatique et les administrateurs travaillent efficacement ensemble pour soutenir les étudiants ;

- Fournir des processus, des outils et des activités de soutien afin que le corps enseignant soit en mesure d'utiliser pleinement les données riches générées par l'analyse pour lui permettre de répondre aux besoins individuels des étudiants et pour développer davantage son enseignement ;
- Clarifier les rôles des différents acteurs (à l'intérieur et au-delà de l'institution) impliqués dans la satisfaction de ces besoins ;
- Assurer une compréhension collective des différents rôles/responsabilités et les relations entre eux ;
- Assurer des hiérarchies claires de responsabilité de gestion et des exigences d'information pour évaluer les performances ;
- Bâtir des relations de soutien et de confiance entre les acteurs concernés (les étudiants, le personnel enseignant, le personnel de soutien, le personnel informatique, les gestionnaires et, le cas échéant, les employeurs).

Les décideurs politiques devraient envisager la nécessité de :

- Clarifier les implications de financement, les résultats escomptés et les délais pour l'innovation ;
- Recueillir et analyser les rétroactions (apprenants, institutions, employeurs, etc.) sur les performances et l'impact et informer tous les acteurs concernés ;
- Identifier les conséquences involontaires de l'innovation (par exemple pour d'autres fonctions, pour élargir la participation ou les liens avec le marché du travail).

Les recommandations politiques relatives aux stratégies de mondialisation et d'internationalisation

Les établissements d'enseignement supérieur devraient envisager la nécessité de :

- Équilibrer les considérations commerciales, éducatives et de réputation dans la formulation de la stratégie internationale globale ;
- Répondre à un éventail de facteurs interdépendants tels que la mobilité (intérieure et extérieure) des étudiants, les stages d'étudiants, la reconnaissance des qualifications, les implications financières, les programmes et les implications pédagogiques et liens avec le marché du travail ;
- Tenir compte des besoins des différents acteurs, y compris des étudiants nationaux et internationaux, du personnel enseignant et de soutien, des organismes d'assurance qualité, des employeurs et des organismes de parrainage ;
- Engager du personnel « local » et établir des relations entre le personnel basé sur les différents campus ;
- Déterminer ce qui peut être « exporté » de l'établissement d'origine et le volume de construction à réaliser afin de tenir compte des facteurs contextuels locaux sur différents campus ;
- Déterminer ce qui peut être « importé » des activités internationales pour remodeler l'institution d'accueil ;
- Satisfaire les différents régimes de réglementation et d'assurance qualité nationaux.

Les décideurs politiques devraient envisager la nécessité de :

- Fournir un appui pour la mobilité entrante et sortante des étudiants.

Zusammenfassung

Einleitung

Die europäischen Institutionen schreiben der Hochschulbildung bei der Erreichung der Ziele der Strategie Europa 2020 eine zentrale Bedeutung zu. In ihren Publikationen der Jahre 2011, 2012 und 2013 hob die Europäische Kommission die Wichtigkeit der Bildung, insbesondere der Hochschulbildung, als Grundvoraussetzung für intelligentes, nachhaltiges und integratives Wachstum hervor. Die vorliegende Studie ist fest in diesen politischen Kontext eingebettet und bietet Belege zu vielen in aktuellen Publikationen der Kommission angesprochenen Themenbereichen rund um Innovationen in der Hochschulbildung. Der Bericht soll insbesondere zum besseren Verständnis der Auswirkungen aktueller Entwicklungen auf die Hochschulbildung beitragen und aufzeigen, inwiefern Neuerungen die Hochschulbildung in Zeiten des Wandels unterstützen können.

Die Studie widmet sich vier übergeordneten Forschungsfragen.

- Was sind die größten Herausforderungen, wenn es um Hochschulbildung und die Förderung von Innovationen in diesem Bereich geht?
- Welche Hauptunterschiede gibt es im regionalen und institutionellen Kontext bei der Erreichung erfolgreicher Neuerungen in der Hochschulbildung?
- Welchen Einfluss haben wichtige Systemkomponenten auf Innovationen in der Hochschulbildung und wie wirkt sich das – direkt und indirekt – auf Systemfunktionen aus? Was sind die wichtigsten Prozesse und die Rollen der wichtigsten Interessenvertreter bei der Umsetzung von Innovationen?
- Was sind die Hauptresultate, die durch Innovationen im Hochschulwesen erzielt wurden, und welche Hindernisse können sich diesen entgegenstellen?

Um die Belegbasis zur Beantwortung dieser Fragen zusammenzustellen und ausgewählte Innovationsprozesse im Bereich Hochschulbildung näher zu beleuchten, wurde auf Sekundärforschung zurückgegriffen und es wurden sieben Fallstudien durchgeführt, die sich in der folgenden Weise mit drei ineinandergreifenden Themenbereichen mit systemübergreifender Bedeutung und den Auswirkungen auf alle Interessenvertreter in der Hochschulbildung befassen:

Fallstudie	Thema
Innovative Herangehensweisen an Lehre und Lernen am Olin College of Engineering (US)	Das sich verändernde Umfeld von Lehre und Lernen in der Hochschulbildung
Kombiniertes Lernen auf Makroebene an der Virtuellen Hochschule Bayern (Deutschland)	
MOOCs aus den USA (Coursera, Udacity, NovoEd)	
MOOCs aus der EU (Plattformanbieter für mehrere und einzelne Institutionen)	
Die Entwicklung von Lernanalysen an der Purdue University (US), University of Derby (UK) und	Technologie und Studienleistung in der

Universiteit van Amsterdam (Niederlande)	Hochschulbildung
Der eAdvisor an der Arizona State University (US)	
Die Internationalisierungsstrategie der University of Nottingham (UK) und die Errichtung von Universitäten in Asien	Globalisierung und Multi-Campus-Universitäten

Analytischer Rahmen

Dieses Projekt zeigt eine innovative Herangehensweise – das Konzept „Innovationssysteme“ wird auf die Hochschulbildung angewandt. So wurde das analytische Konstrukt eines „Hochschulbildungsinnovationssystems“ als Unterbereich eines Innovationssystems entwickelt. Dieses findet sich hauptsächlich in Hochschulinstitutionen, die in enger Verbindung mit anderen institutionellen Bereichen wie der Industrie, Regierungs- und Nichtregierungsbehörden und der Gesellschaft als Ganzes stehen. Ein Hochschulbildungsinnovationssystem kann als Menge von Funktionen, Komponenten und Beziehungen gesehen werden, wodurch es möglich wird, die verschiedenen Interaktionsebenen zwischen den Elementen des Systems voneinander zu trennen und die Entfaltung von Innovation in der Hochschulbildung wie in der nachfolgenden Aufstellung gezeigt zu analysieren.

Hochschulbildungsinnovationssystem		
Funktionen	**Komponenten**	**Beziehungen**
• Bildung • Forschung • Gesellschaftliche Verantwortung („Third Mission“)	• Direkte und indirekte Akteure • Institutionelle und private Akteure	• Zusammenarbeit/Konfliktmoderation • Austausch • Bildung von Netzwerken

Die Anwendung eines systemischen Ansatzes hatte zwei große Vorteile:

- Das Projekt konnte so das allgemeine Konzept Hochschulbildung hinter sich lassen und auf einzelne, konstituierende Elemente eingehen und damit klar herausstellen, wieso und wie Innovation stattfindet und welcher Art diese ist, außerdem, welche Akteure Innovation vorantreiben (oder auch behindern).
- Das Projekt verfolgte also einen dynamischen Ansatz, indem nicht nur Innovation innerhalb der beschriebenen Elemente betrachtet wurde, sondern auch die Interaktion innerhalb und zwischen verschiedenen Komponenten, Beziehungen und Funktionen.

Fallstudien

Alle sieben Fallstudien wurden anhand des Hochschulbildungsinnovationssystemansatzes beurteilt, sodass für jede Studie die Funktion/-en, auf die sich die Initiative konzentrierte, die teilnehmenden Akteure und die Beziehungen, die zwischen den Akteuren aufgebaut wurden, herausgestellt werden konnten. Die sieben Fallstudien werden im Folgenden zusammengefasst.

Olin College of Engineering

Diese Fallstudie untersucht den Lehr- und Lernansatz des Olin College of Engineering. Insbesondere wird der interdisziplinäre Lehrplan des College rund um das „Olin Triangle" dargestellt, das in Zusammenarbeit mit zwei benachbarten Universitäten (das auf Wirtschaft spezialisierte Babson College und das auf freie Künste spezialisierte Wellesley College) Fächer aus Natur- und Ingenieurswissenschaften, Wirtschaft und Betriebslehre sowie Kunst/Geistes- und Sozialwissenschaften anbietet. Das Ziel des Olin College ist die Bereitstellung einer Ausbildung, die ein fundiertes Fachwissen in Technik, die Fähigkeit, Ingenieurskonzepte auf echte Probleme anzuwenden, eine interdisziplinäre Ausrichtung und umfassende Erfahrung in Design vermittelt.

Virtuelle Hochschule Bayern (VHB)

Diese Fallstudie beleuchtet ein Beispiel für eine bildungsorientierte Kooperation zwischen staatlich betriebenen Universitäten in Bayern. Die VHB fördert und koordiniert die Entwicklung und den Einsatz von bedarfsgerechten Online-Lehrangeboten an bayrischen Universitäten für Studierende (kostenlos) und andere (gegen eine geringe Gebühr). Die Onlinekurse werden anhand des „kombinierten Lernens auf Makroebene" entwickelt, d. h. dass der Kurs (Mikroebene) online abgeschlossen werden muss, damit er in den Studiengängen aller Universitäten genutzt werden kann. Die VHB bietet jedoch keinen vollständigen Online-Studiengang: In den Studiengängen (Makroebene) werden die üblichen Kurse vor Ort mit Onlinekursen kombiniert.

MOOCs aus den USA

Die Fallstudie befasst sich mit Coursera, Udacity und NovoEd, Bildungsunternehmen mit Beteiligungskapital, die aus der Stanford University hervorgegangen sind. Sie bieten Onlinekurse zu niedrigen Preisen bzw. kostenlos, die dank Partnerschaften mit verschiedenen Universitäten von tausenden von Studierenden auf der ganzen Welt genutzt werden. Alle drei Unternehmen sind noch jung (Udacity wurde im Januar 2012 gegründet, Coursera im April 2012 und NovoEd im April 2013) und wurden von Professorinnen und Professoren der Stanford University gegründet. Sie sind daher eng mit Stanford und dem Unternehmens- und Beteiligungskapital von Silicon Valley verbunden, was großen Einfluss auf ihre Erschaffung und ihr dynamisches Wachstum hatte. Die Unternehmen sind davon überzeugt, dass sie dazu beitragen können, zugängliche, kostengünstige, motivierende und effiziente Hochschulbildung an die ganze Welt zu vermitteln.

MOOCs aus der EU

In dieser Fallstudie werden drei Initiativen in unterschiedlichen Entwicklungsstadien untersucht: FutureLearn, OpenHPI und Leuphana. FutureLearn ist ein genossenschaftsbasierter MOOC-Anbieter auf Grundlage angesehener Universitäten im Vereinigten Königreich und anderen Ländern in Partnerschaft mit weltbekannten hiesigen Institutionen (British Council, British Library und British Museum) und der britischen Regierung. Die Leitung übernimmt eine gemeinnützige Gesellschaft im Besitz der britischen Open University. FutureLearn ist die Antwort des Vereinigten Königreichs auf die großen MOOC-Anbieter in den USA, insbesondere Coursera, edX und Udacity. Es besteht Unterstützung von höchster Ebene: der Regierung des Vereinigten Königreichs. Im Gegensatz dazu sind die zwei deutschen Fälle eher Nischenanbieter mit starker Unterstützung der Regionen und der Privatwirtschaft. OpenHPI ist eine Entwicklung des Hasso-Plattner-Instituts (HPI) der Universität Potsdam. Leuphana ist eine öffentliche

Universität in Norddeutschland und nutzt seit Januar 2013 die Marke Leuphana Digital School als Plattform für ihr Online-Lehrangebot.

Lernanalysen an der Purdue University, University of Derby und Universiteit van Amsterdam

In dieser Fallstudie werden innovative Herangehensweisen an die Nutzung der Studierendendaten zur informierten Entscheidungsfindung mithilfe von Lernanalysen von drei Universitäten geprüft. Die konkreten Beispiele sind:

- Purdue University (US) mit Course Signals zur Erhöhung der Studienerfolge in Präsenzveranstaltungen. Course Signals spürt frühzeitige Warnzeichen auf und bietet Studierenden, die nicht ihre bestmögliche Leistung erbringen, schon vor Erreichen eines kritischen Punktes Hilfestellungen. Es ist einfach anzuwenden und bietet häufige, kontinuierliche Rückmeldungen in Echtzeit. Darüber hinaus bietet es schon früh Hilfestellungen – bereits ab der zweiten Studienwoche.
- Die University of Derby (UK) erforscht Strategien in Bezug auf Prozesse, die zur Verbesserung der Studienleistung führen, und stellt dabei Schlüsselfragen wie: (i) Was geht bei den Studierenden tatsächlich vor und wie können wir dies in Erfahrung bringen? (ii) Welche Berührungspunkte gibt es zwischen Studierenden und Hochschule? (iii) Welche „digitalen Fußabdrücke" hinterlassen die Studierenden in der Institution? (iv) Was ist den Studierenden wirklich wichtig?
- Die niederländische Universiteit van Amsterdam (UvA) und die Vrije Universiteit Amsterdam (VU) arbeiten mit Mitteln der SURF an der Durchführung einer Pilotstudie zu Nutzungsanforderungen für Lernanalysen. Mögliche Visualisierungsformen der Daten durch Lehrkräfte wurden für (i) die Nutzung von E-Learning-Material durch Studierende, (ii) die Reihenfolge, in der die Lernmaterialien genutzt werden und (iii) das Vorhandensein einer eventuellen Beziehung zwischen der Anzahl verwendeter Materialien und Studienergebnissen untersucht.

Der eAdvisor an der Arizona State University (ASU)

Beim e-Advisor handelt es sich um das elektronische Beratungs- und Abschlussnachverfolgungssystem der ASU. Moderne Technologie und Datenanalyse werden dazu verwendet, Studierenden bei der Entscheidung für ein Hauptfach zu helfen, das ihren Interessen entspricht, und somit sicherzustellen, dass der Abschluss erreicht wird. Das Hauptziel der Initiative ist die Erhöhung der Studierendenbindung und Abschlussrate und die Bereitstellung von hochwertiger Bildung zu erschwinglichen Kosten für eine steigende Anzahl an Studierenden.

Die Internationalisierungsstrategie der University of Nottingham (UK) und die Errichtung von Universitäten in Asien

In dieser Fallstudie werden die Internationalisierungsstrategien der University of Nottingham analysiert, die ihren Anfang im Aufbau zweier internationaler Hochschulen in Malaysia und China in den 90er Jahren nahmen. Diese Innovation wird als Teil eines tieferen und breiteren Institutsprozesses gesehen: Nottingham sollte nicht nur zu einer globalen Universität werden, sondern die Identität, Mission und Arbeitsweise der damals sehr konservativen Hochschule sollten dynamischer, vorausschauender und kreativer werden. Die Initiative wird als „befreiende Störmaßnahme" gesehen. Das allgemeine Ziel, das mit der Errichtung der zwei Hochschulen in Asien, nämlich in Semenyih, Malaysia, im Jahr 2000 und Ningbo, China, 2004, verfolgt wurde, war die Erschaffung einer anderen Identität und Gestalt der Universität, als es alleine im Vereinigten Königreich möglich gewesen wäre, außerdem die schrittweise Einbettung einer Innovationshaltung und einer internationalen Sichtweise in der gesamten Universität.

Hauptresultate

Die Resultate der Studie sind um die vier übergeordneten Forschungsfragen herum strukturiert und spiegeln den analytischen Rahmen wider, der der Studie als Rückgrat dient. Die Hauptresultate werden im Folgenden zusammengefasst:

Die wichtigsten Herausforderungen für eine Hochschulbildung, die auf Innovation ausgerichtet ist

Es kristallisieren sich drei Hauptherausforderungen für die Hochschulbildung weltweit heraus, die gleichzeitig die Innovation dieser Branche antreiben: (i) Druck durch Globalisierung; (ii) veränderliche Angebot-Nachfrage-Situation; und (iii) Änderungen in der Finanzierung. Verschiedene Innovationspraktiken werden entwickelt und eingesetzt, um diese Herausforderungen anzugehen. Ein und dieselbe Herausforderung kann zur Einführung verschiedenster Innovationspraktiken in unterschiedlichen institutionellen Kontexten führen, während ein und dieselbe Innovationspraktik gleichzeitig in verschiedensten Herausforderungen begründet liegen kann.

Kontexte für erfolgreiche Innovationen

Erfolgreiche Innovationspraktiken benötigen ein Zusammenspiel zwischen nationalen/regionalen und institutionellen Faktoren. Die Art der Faktoren hängt von verschiedenen Einflussgrößen wie Umfang der Initiative und Autonomie einer Institution ab. Hinsichtlich des ersteren lässt sich sagen, dass der Einfluss nationaler/regionaler Faktoren um so größer ist, je weiter der Umfang gefasst wird; je mehr Begrenzungen es für den Umfang gibt, desto höher wird der Einfluss institutioneller Faktoren. Zum letzteren ist festzuhalten, dass autonomere Hochschulbildungsinstitutionen mit mehr Steuermöglichkeiten bezüglich ihrer finanziellen Mittel und der Zuteilung dieser Mittel auf ihre Funktionsbereiche tendenziell eher Bottom-up-Praktiken entwickeln. Der direkte Einfluss dieser Innovationsarten kann unmittelbarer, jedoch auch weniger breit gefasst sein, da sich häufig auf die innovationsstiftende Institution beschränkt wird. Weniger autonome Hochschulbildungsinstitutionen tendieren hingegen dazu, eher staatlich initiierte Top-down-Methoden zur Innovationsförderung anzuwenden. Dies muss die Innovationskraft nicht mindern, sondern führt im Gegenteil dazu, dass weiterreichende Beziehungen und Prozesse über das Hochschulbildungssystem hinweg unterstützt werden und größere Zeiträume für die Umsetzung veranschlagt werden, was einen langfristigeren und größeren Einfluss über Institutionsgrenzen hinaus haben kann.

Komponenten, Funktionen und Beziehungen eines Hochschulbildungsinnovationssystems

Die Entwicklung und Umsetzung von Innovationen in Hochschulbildungssystemen beeinflussen sämtliche Systembestandteile: Komponenten, Beziehungen und Funktionen. Auf Komponentenebene ist eine Vielzahl direkt und indirekt betroffener Einzelpersonen und Institute durch diese Innovationen betroffen. Bezüglich der Beziehungen entstehen die wichtigsten Auswirkungen durch Kooperation, den Aufbau von Netzwerken und eine erhöhte Mobilität, was traditionelle Beziehungen zwischen Akteuren ändern sowie neue Beziehungen entstehen lassen kann. Bei den Funktionen wird maßgeblich die Lehrfunktion beeinflusst, mit einem weniger ausgeprägten, doch wachsenden Einfluss auf die Forschungs- und Gesellschaftsfunktion. Dies liegt wahrscheinlich daran, dass sich viele der untersuchten Innovationspraktiken noch in einer frühen Phase befinden, und ist weniger als Folge einer untergeordneten Bedeutung der Innovation zu sehen. Der Einfluss einiger Innovationspraktiken auf andere Systemfunktionen wie Forschung und gesellschaftliche Verantwortung wird sich daher höchstwahrscheinlich noch ausweiten und im Laufe der Zeit stärker hervortreten, wenn die Innovation reift und stärker in das Hochschulinnovationssystem eindringt. In einem innovativen Hochschulbildungssystem scheinen drei Entwicklungsaspekte am bedeutendsten:

- Je tiefer die Innovation in das Hochschulbildungssystem eindringt und je umfassender dessen Elemente betroffen sind, desto besser muss der Innovationsprozess verwaltet werden. Managementmethoden werden zwar in vielen Universitäten gelehrt, Universitätsmanager sind jedoch nicht hierfür ausgebildet und meist beförderte Angestellte aus der Wissenschaft.
- In einem innovativen Hochschulbildungssystem bedingen sich Änderungen oft gegenseitig: Systembestandteile (Komponenten, Beziehungen und Funktionen) beeinflussen den Erfolg der Innovation, während der Erfolg der Innovation weitere Änderungen für die Systembestandteile mit sich bringt. So ergibt sich eine Änderungsspirale, die das Hochschulbildungssystem besser auf Umweltänderungen reagieren lässt.
- Die hier untersuchten Änderungen auf Hochschulbildungsinnovationssysteme durch die Innovationspraktiken sind nicht radikaler Natur sondern vollziehen sich eher langsam und allmählich. Viele Innovationspraktiken modifizieren die traditionellen Funktionen von Hochschulbildungsinstitutionen nicht in radikaler Weise, sondern bieten eher neue Herangehensweisen an traditionelle Aufgaben, sodass besser auf veränderliche Anforderungen in der Hochschulbildung eingegangen werden kann.

Resultate und Störfaktoren

Es zeigen sich vier Hauptinnovationsresultate in der Hochschulbildung: (i) Die Vision und die Nutzung neuer Technologien begünstigen Innovationspraktiken und stellen meist keine direkten Innovationen dar; (ii) die Nutzung neuer Technologien scheint ein Wegbereiter für den Übergang von einer abteilungszentrierten Bildungsvision zu einer studierendenzentrierten zu sein; (iii) Innovation setzt häufig eine beschleunigte Entwicklung von Partnerschaften zwischen Hochschulbildungsinstitutionen und anderen Organisationen, insbesondere Unternehmen, in Gang; (iv) Innovationen in der Hochschulbildung sind ein gutes Beispiel für zwei allgemeine Hauptaspekte im Innovationsprozess: „Neues wagen" und „Bestehendes verbessern".

Störfaktoren für Innovationen finden sich sowohl auf Institutsebene, wie beispielsweise mangelnde Unterstützung der Innovationspraktiken durch die Institution, und auf Länder-/Regionalebene, z. B. durch den Einfluss der unterschiedlich ausgeprägten Autonomie von Hochschulbildungsinstitutionen. Rechtliche Rahmenbedingungen sind auch ein entscheidender Faktor, der Innovationspraktiken empfindlich behindern kann. Trotz möglicher Störfaktoren haben Innovationspraktiken das Potential, qualitativ hochwertige und vernünftige Resultate zu erzielen, sei es in Bezug auf eine bessere Zugänglichkeit von Hochschulbildung, der Fokussierung auf Studierende als zentrale Akteure im System oder auch die Schaffung möglicher Auswege aus finanziellen Engpässen, die das System belasten.

Handlungsempfehlungen
Die Handlungsempfehlungen sind in drei zentralen Themen zusammengefasst, die sich in der Studie gezeigt haben, und orientieren sich an zwei bestimmten Zielgruppen: Hochschulbildungsinstitutionen und politische Entscheidungsträger.

Handlungsempfehlungenzum veränderlichen Umfeld von Lehre und Lernen in der Hochschulbildung

Hochschulbildungsinstitutionen sollten prüfen, ob Folgendes notwendig ist:

- Förderung einer Institutionskultur, die die Kreativität erhöht, ein Bewusstsein für die Vorteile schafft, die aus der Umsetzung von Innovationen erwachsen, Offenheit gegenüber Innovationen anregt und Widerstände gegen Veränderungen abbaut;
- Einsatz von Anreizen und Belohnungen für Angestellte (einschließlich wissenschaftlich Tätiger), die innovative Praktiken einsetzen;
- Ermunterung der Fakultätsmitglieder, das Potential neuer Lerntechnologien voll auszuschöpfen;
- Aufbau einer institutionsübergreifenden Zusammenarbeit, um die Auswahl und Qualität für Studierende zu erhöhen (und dabei möglicherweise noch die Kosten zu senken);
- Einsatz geeigneter Maßnahmen zur Entwicklung der Fähigkeiten des Lehrpersonals und zur besseren Zusammenarbeit in der Lehre;
- Prüfung bestehender organisatorischer Beschränkungen und Verbindungen.

Politische Entscheidungsträger sollten prüfen, ob Folgendes notwendig ist:

- Aufbau eines eindeutigen rechtlichen Rahmenwerks zur Ansprache von Störfaktoren, denen sich manche Entwicklungen des Online-Lernens aktuell gegenübersehen, wie beispielsweise: unpassende Qualitätssicherungsmechanismen, fehlende Credit-Anerkennungsprozesse und Regelungen zu geistigem Eigentumsrecht.

Handlungsempfehlungenzu Technologie und Studienleistung in der Hochschulbildung

Hochschulbildungsinstitutionen sollten prüfen, ob Folgendes notwendig ist:

- Identifizierung der (diversen) Bedürfnisse und Umstände der Lernenden;
- Sicherstellung, dass die Lernenden Zugang zu den nötigen Technologien haben und fähig sind, diese entsprechend zu nutzen;
- Anerkennung der Abhängigkeit einer erfolgreichen Einführung von Lernanalysen von der gewählten Technologie, aber auch von der Durchführung der notwendigen Änderungen innerhalb der Institution, sodass Lehrende, IT-Angestellte und Administration in der Unterstützung der Studierenden effizient zusammenarbeiten können;
- Bereitstellung entsprechender Prozesse, Werkzeuge und Unterstützungsaktivitäten, sodass die Fakultät die reichhaltigen Daten, die durch die Analyse erzeugt wurden, in vollem Umfang nutzen kann und somit auf die

individuellen Bedürfnisse der Studierenden eingehen und die Lehre weiter verbessern kann;
- Klärung der Rollen der verschiedenen Akteure (innerhalb und außerhalb der Institution), die in die Erfüllung dieser Bedürfnisse involviert sind;
- Sicherstellung einer gemeinsamen Basis bezüglich des Verständnisses der unterschiedlichen Rollen/Verantwortlichkeiten und der Beziehungen zwischen diesen;
- Sicherstellung einer klaren Linie in Managementverantwortung und Informationsbedürfnissen, um die Leistung zu beurteilen;
- Aufbau von unterstützenden Beziehungen und Vertrauen zwischen den betroffenen Akteuren (Studierende, akademische, Support- und IT-Angestellte, Manager und gegebenenfalls Arbeitgeber).

Politische Entscheidungsträger sollten prüfen, ob Folgendes notwendig ist:
- Klärung der Finanzierungsbedingungen, beabsichtigten Resultate und Zeitpläne für die Innovation;
- Einholung und Analyse von Rückmeldungen (von Lernenden, Institutionen, Arbeitgebern etc.) zur Leistung und Wirkung und Information aller betroffenen Akteure;
- Identifizierung von unbeabsichtigten Folgen der Innovation (z. B. auf andere Funktionen, zur Ausweitung der Teilhabe oder auf den Arbeitsmarkt).

Handlungsempfehlungenzu Globalisierung und Internationalisierungsstrategien

Hochschulbildungsinstitutionen sollten prüfen, ob Folgendes notwendig ist:
- Herstellung eines ausgewogenen Verhältnisses zwischen kommerziellen, bildungs- und ansehensbezogenen Gesichtspunkten beim Formulieren der Internationalisierungsstrategie;
- Ansprache einer Reihe ineinandergreifender Faktoren wie Studierendenmobilität (ein- und abgehend), Studierendenpraktika, Qualifikationsanerkennung, Finanzierungsbedingungen, Auswirkungen auf den Studienplan und pädagogische Gesichtspunkte sowie den Arbeitsmarkt;
- Miteinbeziehung der Bedürfnisse verschiedener Akteure wie in- und ausländische Studierende, wissenschaftliche und Support-Mitarbeiter, Qualitätssicherungsagenturen, Arbeitgeber und Sponsoren;
- Motivierung von Angestellten der eigenen Universität und Aufbau von Beziehungen zwischen Angestellten der verschiedenen Hochschulen;
- Feststellung, wie viel von der eigenen Institution „exportiert“ werden soll und was aufgebaut werden soll, um örtliche Kontextfaktoren an den verschiedenen Hochschulen widerzuspiegeln;
- Feststellung, wie viel von den internationalen Aktivitäten in die eigene Institution „importiert“ werden soll;
- Erfüllung der verschiedenen nationalen rechtlichen und Qualitätssicherungsvorschriften.

Politische Entscheidungsträger sollten prüfen, ob Folgendes notwendig ist:

- Unterstützung von Aufenthalten der eigenen Studierenden an anderen Hochschulen und Aufnahme von Studierenden anderer Hochschulen.

1. Introduction

In meeting the objectives of the Europe2020 strategy, European institutions assigned a central role to higher education. The European Commission (EC), in subsequent communications released in 2011, 2012 and 2013, stressed the importance of education – and higher education in particular – as a key enabler of smart, sustainable and inclusive growth. The concept of innovation in higher education finds place in all the recent communications through a pledge on the side of the EC to foster, among others, the use of e-learning and blended learning, to promote interactive learning environments (European Commission 2011: 6), to make greater use of ICT and Open Educational Resources (OER) (European Commission 2012: 8, 9), to embrace more widely digital learning (European Commission 2013a: 7, 8), and to create the conditions for 'more open learning environments to deliver education of higher quality and efficacy' (European Commission 2013b: 2).

This study is firmly framed within this policy context, providing primary evidence on many of the themes that recent EC communications touch upon as far as innovation in higher education is concerned. The report aims in particular to contribute to a better understanding of recent developments in higher education and provide evidence of how innovation can support higher education in times of change.

The study builds on **four research questions**, which have guided the work since the inception phase of the project:

- What are the main challenges facing higher education and driving innovation in this sector?
- What are the key differences in terms of regional and institutional contexts for achieving successful innovation in higher education for different constituencies?
- How does innovation in higher education involve key system components and how does it influence – directly and indirectly – the system functions? What are the key processes and the roles of the key stakeholders in implementing innovation?
- What are the major outcomes of innovation in higher education and what bottlenecks and blockages exist in achieving them?

In order to gather the necessary evidence to answer these questions and to shed light on selected processes of innovation in the higher education sector, desk research and seven case studies have been conducted. The seven case study monographs are provided in annex to this report and they constitute a major output of the project. This report, in turn, brings together the evidence collected through the desk- and field- work and provides an analysis structured along three interconnected themes with system-wide significance and implications for all higher education stakeholders, as follows:

Table 1: Case studies based on themes

Case study	Theme
Innovative approaches to teaching and learning at the Olin College of Engineering (US).	The changing landscape of teaching and learning in higher education.
Macro-level blended learning at the Bavaria Virtual University (Germany).	
US- originated MOOCs (Coursera, Udacity, NovoEd).	
EU-originated MOOCs (multi- and single- institution platform providers).	
The development of Learning Analytics at Purdue University (US), University of Derby (UK), and University of Amsterdam (the Netherlands).	Technology and the student performance in higher education.
The eAdvisor at Arizona State University (US).	
The internationalisation strategy of the University of Nottingham (UK) and the establishment of campuses in Asia.	Globalisation and multi-campus universities.

Methodologically, the case studies have been selected with a view to capturing a variety of innovation practices currently developing across the globe. They were identified through a wide consultation process involving over 30 stakeholders in the higher education sector, the project steering group at the EC and the project's peer group of experts. The underlying principle of the consultation that led to the identification and selection of case studies was to establish a link between challenges (as identified and discussed in section 1.1) affecting the higher education sector and innovative practices that higher education institutions are putting in place as a response to such challenges. The case studies provide insights into processes of innovation that will have applicability to many other contexts.

The three themes have been examined against the background of several contextual factors and challenges that higher education is faced with, which are briefly described below in order to set the scene for our analysis.

1.1 Setting the scene: contextual factors and challenges

In this section, several contextual factors and challenges that affect the higher education sector and drive innovation within it are discussed, drawing on a brief literature review.

1.1.1 Contexts

The context-specific nature of innovation in higher education is illustrated by the influence of various organisational and systemic factors, as well as other factors that pertain to wider societal circumstances.

Organisational context

The 'exceptionalism' claims of universities as organisations typically refer to the importance of academic freedom and autonomy in the performance of universities' main functions and capacity for innovation. On the other hand, academic freedom and autonomy are sometimes claimed to create a lack of responsiveness to the needs of external stakeholders and unwillingness to collaborate with actors in other forms of organisations (Amaral et al., 2003; Shattock, 1999). Other organisational factors that impact on the capacity to innovate in higher education pertain to the university governance structure and the people (students, staff) that inhabit the institutions. In the former case, university governance structures may have an inhibiting effect on innovation, as in some cases, relatively lower levels of loyalty to the institution than loyalty to the academic disciplines of academic staff have been reported. In the latter case, successful innovation often stems from individual enthusiasm and persistence. Innovations are also closely related to the specific institutional (local) context and the related institutional mission.

Systemic context

At the system level, higher education has expanded significantly and became increasingly differentiated and diversified in recent decades. The differentiation and diversification are notable at several levels, e.g. in the structure of the student body and in the nature of student learning needs, and in the nature of inter and intra-institutional structures and relationships. The extent of differentiation can be reflective of national and regional differences in economic characteristics especially, but also in student population characteristics. Another important feature is the increasing internationalisation of higher education systems. Universities increasingly play a part in a globalised world, competing for the best students, internationalised student populations and international quality benchmarks. Innovations can respond differently to systemic contextual factors and institutions can make different choices.

Wider context

Wider contextual features concern the changing nature of the societies of which higher education institutions are a part. As described by Valima and Hoffman (2007), wider societal changes have implications for higher education in terms of the nature and role of knowledge production, the changing role of the state, higher education's relationships with civic society and, above all, the role of information and communication technology. The ways of communication and knowledge exchange changed rapidly over the last decades, influencing the way universities distribute their knowledge and interact with society. The readily available knowledge on the internet has, in some instances, reduced the role of universities as guardians of knowledge and the conceived authority of scientists in societal debates.

1.1.2 Challenges

Against the background of the contextual factors just described, the broad groups of inter-connected challenges that the higher education sector is faced with have been identified: pressures from globalisation processes, changing supply of and demand for higher education, and changes in higher education funding. It is worth noting that the term 'challenge' as used in this report denotes both 'opportunities to be seized' and 'obstacles to be overcome'. Especially concerning the former, it is also recognised that these challenges are not necessarily unique to higher education, although the responses to them may well need to be. While the main focus of this report is on the education function of higher education, it is recognised that there are also challenges for the research and engagement functions, and for the inter-relations between them.

Pressures from globalisation processes

Globalisation has been identified as a crucial challenge for the higher education sector, bringing with it a weakening of national system boundaries, changing criteria of excellence and new forms of competitiveness between institutions (Ball, 2012; Brooks and Waters, 2011; Teichler, 2007). This is about much more than competition to recruit international students, and includes the importance of achieving global recognition for the relevance and standards of courses and qualifications in order to meet the labour market needs of all students (Brooks and Waters, 2011). The increasing cross-border operations of many higher education institutions, the increased mobility of both students and staff, as well as new international opportunities provided by the use of technology as a 'disruptive enabler', combine to challenge many of the well-established practices in individual institutions. Similarly, at the national level, global trends increasingly act as a reference point for national policies, especially in areas such as quality assurance, qualification structures and links to the labour market. However, as indicated later in this report, higher education institutions respond to the challenges of globalisation in different ways. These reflect both contextual differences, as well as different appraisals of the opportunities presented by globalisation.

The changing supply of and demand for higher education[1]

'Supply-side' developments pose crucial challenges for the higher education sector, arising especially from the use of new teaching and learning technologies. Online learning environments have been growing on the side of traditional learning environments and in some instances have started to replace them. The growing interest in Massive Open Online Courses (MOOCs) and forms of blended learning are prime examples of supply-side developments in teaching and learning. Furthermore, technologies may also have an impact outside the classroom, as exemplified by the use of Learning Analytics (and similar initiatives) that may affect the traditional conception of the overall student experience in higher education, and indeed influence the students' performance. These developments have implications for pedagogic practices in all higher education institutions, and for those who learn or teach (or support learning in other ways) in them.

The demand side is undergoing substantial changes as well. These include the changing students' financial circumstances, the need of many to combine paid work or domestic duties with their higher education, anxieties about employment opportunities, for some a desire to travel and for others a desire to remain at home, changing preferences for subjects of study, study methods, the extent of engagement with the non-academic features of university life (Orr, 2012) and changing lifestyles, influenced for instance by widespread use of social media (Fuller et al., 2011). New expectations on the side of students are accompanied by changing needs of employers (as labour market stakeholders of universities and future employers of the students) regarding the numbers and kinds of graduates (Brown et al., 2004; Schomburg and Teichler, 2006). Employers' expectations are inevitably interlinked with broader societal/economic changes regarding workforce development with growing demands for lifelong and work-based learning (lifelong learning as facilitator of mid-career changes).

In responding to the growing diversity of external demands, an increasing differentiation of higher education institutions is occurring, bringing with it questions and challenges for individual institutions as to what kind of higher education institution they want to become. This

[1] The terms 'supply' and 'demand' are not used here solely in their economic meanings. 'Supply' potentially encompasses all internal features of higher education institutions, while 'demand' refers to the external environment in which they operate,

includes consideration of the balance of emphasis given to education, research and engagement functions, and to the relationships between them.

Changes in higher education funding

The expansion of higher education in recent decades is one of the causes that have inevitably led to increasing costs and to growing debates about who should meet those costs, e.g. the balance between the state and the consumer/student when it concerns the education function, and the balance between the state and businesses/users when it concerns the research and engagement functions. More broadly, financial pressures on the higher education sector derived from increasing demand bring to the fore questions on cost-sharing and the balance between individuals' contribution to the cost of higher education and the contribution of society at large, notably through public funding (Barr, 2004; Woodhall, 2007). This inevitably entails consideration of both the 'individual' and the 'societal' benefits of higher education and of the relationships between them (Brennan et al., 2013). There is currently considerable differentiation between national systems in funding arrangements, and changes in funding typically affect some institutions and subject areas more than others. The challenges of funding are creating considerable uncertainty within many countries and institutions.

In responding to a changing funding situation, higher education must either find ways of cutting costs or of generating additional revenue, or both. This implies looking at how current activities are being performed and finding new (and cheaper) ways of doing them, as well as undertaking new activities, possibly for new markets. But for doing anything new, financial viability concerns are raised. Thus, pressures to innovate increase, but concerns about the costs of innovation also grow. Private providers of higher education also play a role in funding. Examples of private providers providing low cost alternatives to public higher education can be found in some countries, while in others they represent an elite high cost and highly selective sector (Jongbloed, 2010; Strehi et al., 2006).

1.2 Structure of the report

The report follows the structure presented below:

- **Chapter 2** introduces the concept of 'innovation systems' and the perspective of a higher education innovation system as a sub-set of an innovation system, concentrated particularly in higher education institutions (universities and associated research institutes, vocational training institutions, master's colleges, etc.), which are seen in close connection with other institutional spheres, such as industry, government and non-government agencies, and the society at large. The higher education innovation system has been used as the analytical framework guiding the primary research undertaken within this project, i.e. the seven case studies. The three main elements of the higher education innovation system, namely functions, components and relationships are discussed in detail;
- **Chapters 3 to 5** discuss the three main themes identified in the project, connecting evidence from the literature with that from the seven case studies;
- **Chapter 6** provides the conclusions, clustered around the four overarching research questions, and a set of recommendations, grouped according to the three themes that emerged from the case studies, and targeting higher education institutions and policy-makers.

2. Analytical Framework

This chapter describes the building blocks deployed to frame the primary research conducted within this project through the seven case studies.

2.1 Introduction: defining innovation

We start from a broad definition of innovation, which is an adaption of the OECD definition contained in the Oslo Manual to the higher education sector. In this study, innovation is defined as:

> A new or significantly improved **product**, **process**, **organisational method** or an **organization** itself developed by or having a significant impact on the activities of a higher education institution and/or other higher education stakeholders.

In view of improved understanding of the nature and dynamics of innovation in the higher education sector, we introduce the concept of a 'higher education innovation system' as an analytical construct that synthesises the key features of the higher education sector into an 'innovation system' format defined according to systems theory as a set of components, relationships and functions (Carlsson and Stankiewicz, 1991; Carlsson, 1998, 2003; Carlsson et al., 2002; Hekkert et al., 2008). This conceptual framework offers a broad perspective for understanding the sources, dynamics and development paths of innovation in higher education and delineates how new regimes appear through creative reconstruction. We start with a brief introduction of the 'innovation systems' concept and on that basis, make the transition to higher education innovation systems as a sub-set of innovation systems.

2.2 The 'innovation systems' concept

The 'innovation systems' concept was introduced in the late 1980s to examine the influence of knowledge and innovation on economic growth in evolutionary systems where institutions and learning processes are of central importance (Freeman, 1987; Freeman and Lundvall 1988). The systems perspective was used to better understand how institutional arrangements can facilitate interactions among economic actors in market- as well as non-market knowledge transfer (Carlsson, 2003). The concept was refined as 'national innovation systems' (NIS) which includes a set of innovation actors (firms, universities, research institutes, financial institutions, government regulatory bodies, etc.), their activities and their inter-linkages at the aggregate level (Freeman, 1987; Dosi et al., 1988; Lundvall, 1988; 1992; Nelson, 1993; Edquist, 1997, 2005). The 'national' dimension of innovation systems[2] favoured user-producer interactions through cultural and institutional proximity and localised learning (Lundvall, 1992), but became increasingly blurred due to business and technology internationalisation extending technological capabilities beyond national borders, and the growing integration of innovation systems, driven by the economic and political processes, e.g. the European Union consolidation.

As the NIS approach did not fully capture the interactions between innovation actors, more disaggregated levels of the innovation system were introduced, such as:

[2] In the sense of specific national factors, like history and culture, institutions, laws and policies that shaped technological capabilities of a country.

- Regional Innovation Systems (e.g. Cooke, 1996; Malmberg and Maskell, 1997) emerged in the context of the increasing regionalisation of the early 1990s at technological, economic, political or cultural levels in many countries. The concept comprised for example, a set of regional actors aiming to reinforce regional innovation capability and competitiveness through technological learning (Doloreux and Parto, 2005), regional 'technology coalitions' arising from geographical distribution of economic and technological effects over time (Storper, 1995), or dynamic, self-organizing business environments (Johansson et al. 2005), etc.;
- Sectoral Innovation Systems (Breschi and Malerba, 1997; Malerba, 2002) examine industry structure as a determinant of firm's performance heterogeneity and explore coordination forms in supply chains (hierarchy, market and hybrid forms);
- Technological Innovation Systems (Carlsson and Stankiewicz, 1991; Carlsson, 1997; Bergek et al., 2007) focus on the network of agents that interact in function of a specific technology or set of technologies.

All these system frameworks are generally characterised by three elements (Carlsson and Stankiewicz, 1991; Carlsson, 1998, 2003; Carlsson et al., 2002; Hekkert et al., 2008):

- **Components (and boundaries)** of the system include various actors that normally interact in the process of innovation (individuals and firms, higher education and research institutions, government agencies, trade associations and other units making up the institutional infrastructure). The boundaries between components can be more easily identifiable, e.g. when they are defined by geography or administrative units as in the case of spatially bounded systems (regional, NIS), or more difficult, as in the case of spatially open systems (e.g. technology innovation systems bounded by 'technology' or sectoral innovation systems, bounded by 'sector');
- **Relationships** among system components, which include new knowledge combinations generated by the innovation actors, either through their own efforts or by using technology transfer from other actors, provided they have sufficient absorptive capacity. Internal R&D capacity of the actors is essential in this process, but non-R&D (non-market) interactions are also important;
- **Functions** of the system, in the sense of competencies of the components that determine the system's performance. The main function of an innovation system is defined as the generation, diffusion and utilization of technology, while the competencies necessary to achieve this function are described as four types of capabilities: (i) selective (strategic) capability, (ii) organizational (integrative or coordinating) ability, (iii) technical or functional ability; and (iv) learning (adaptive) ability.

This definition of innovation systems takes into account not only the system's structure, but also the processes (dynamics and achievements) in which the system is involved, as a complement to the system structure, in order to capture the dynamic evolution of the system in a so-called 'structure/process approach' of innovation systems (Bergek et al., 2007).

2.3. From innovation systems to higher education innovation systems

Building on the structure/process characterisation of innovation systems discussed above, we define a higher education innovation system as a sub-set of an innovation system, concentrated particularly in higher education institutions (universities and associated research institutes, vocational training institutions, master's colleges, etc.[3]), which are in close connection with other institutional spheres, such as industry, government and non-government agencies, and the society at large. The concept of 'higher education system' can be applied at a national level, but it can also have a local, regional or global focus, as higher education activities occurring at these levels cut across national boundaries (Castells, 1996).

A higher education innovation system can also be seen as a set of **functions**, **components** and **relationships**, which allow us to disaggregate the various levels of interactions among the elements of the system and analyse the unfolding of innovation in higher education, as summarised in Table 2.

Table 2: Structure of a higher education innovation system

Higher education innovation system		
Functions	**Components**	**Relationships**
• Education; • Research ; • Engagement ('third mission').	• Direct and indirect actors; • Institutional and individual actors.	• Collaboration / conflict moderation; • Substitution; • Networking.

2.3.1. Functions of the system

Higher education is a crucial sector for the **production**, **dissemination** and **transfer of economically productive knowledge**, **innovation and technology** in today's knowledge economy (Naidoo, 2010).

If innovation systems theory defines the main function of an innovation system as the generation, diffusion and utilization of technology (e.g. Carlsson et al 2002: 235), we identify the **central functions** of higher education as providing education, undertaking research, and a 'third' mission of service to society, community engagement and entrepreneurialism, which covers the entire spectrum of activities directed to knowledge transmission, knowledge creation and knowledge transfer[4] (Table 3).

In our approach, the emphasis is placed on the first function: education. This function is closely related with the other two functions. We look at the functions of higher education systems in a dynamic way, considering how innovation within one function can have an impact on the other functions as well.

[3] See e.g. the Carnegie Classification of Institutions of Higher education in the US, which defines All-Inclusive Classifications (e.g. Undergraduate Instructional Program, Graduate Instructional Program, Enrolment Profile, Undergraduate Profile, Basic classification) and Elective Classifications (e.g. Community Engagement). http://classifications.carnegiefoundation.org/

[4] We also note that there is a substantial academic literature which refers to functions in rather different terms. For example, Martin Trow's distinctions of 'elite', 'mass' and 'universal' functions are defined respectively as 'shaping the mind and character of a ruling class and the preparation for elite roles', 'the transmission of skills, preparation for a broader range of technical and economic elite roles' and the 'adaptation of a 'whole population' to rapid social and technological change' (Trow 2006, 556). Manuel Castells has written about 'contradictory functions' of universities in responding to 'multiple pressures', citing as an example the functions of 'selection and socialisation of a dominant elite' and 'training of a skilled labour force' (Castells, 2001). More broadly, contradictory functions of education systems have been described by Moore in terms of 'liberal' and 'elite reproduction' theorists (Moore, 2004).

Table 3: Overview of functions of higher education systems

Functions of higher education systems		
Education	**Research**	**Third mission**
• Teaching and learning; • Curriculum development; • Student assessment; • Student mobility ; • Accreditation.	• New knowledge creation ; • Testing and measurements; • Experimentation; • Validation of results; • Dissemination of results, etc.	• Protection of Intellectual property; • Creation of spin-offs; • Contracts with industry; • Contracts with public bodies ; • Participation in policy-making; • Involvement in social and cultural life; • Public understanding of science[5].

2.3.2. Components of the system

The components of a higher education innovation system primarily include the individual and institutional actors who contribute to generating, diffusing and using innovation in the system. They can act both within and outside the higher education sector, but have a direct interest in the higher education sector. These can be considered as direct actors.

Direct individual actors include:

- Students, which can variously be defined as 'junior members', 'consumers' and, of course, 'learners';
- academic staff (faculty, teaching and research assistants, coaches and mentors, etc.), differentiated in terms of seniority and authority levels, with significant differences in the power of the university professors between different national systems (Kehm and Teichler, 2012);
- Other staff (e.g. academic administrators and an increasing numbers of new 'professionals' who bridge the traditional divide between academic and administrative roles (Whitchurch, 2010,) such as technology transfer managers, IP experts, patent attorneys, etc.

Direct institutional actors include: universities with their departments, schools and labs, associated research institutes (often interdisciplinary), technology transfer offices and industrial liaison offices, business support institutions (science parks, business and technology incubators, start-up accelerators), financial support institutions (public and private venture capital firms, angel networks, seed capital funds, etc.)

In addition, a higher education innovation system may be also be shaped by indirect actors, such as individuals, organisations, or institutions from the social, economic, and political

[5] Schoenet al 2006, as cited in Laredo 2007

spheres at national, regional and local governments, 'users' of the knowledge created or of the trained manpower produced, such as businesses and employers' organisations, as well as society at large, and networks of academics, alumni and others, who possess the power to bestow status and reputation. They do not play an active role in the higher education sector, but are still indirectly affected and need therefore to be taken into account.

Higher education innovation systems acknowledge the importance of individual innovators (scientists, students, entrepreneurs, etc.) and their role in initiating and consolidating institutional processes in higher education. Innovation actors in higher education may have different roles in different situations and a single actor may play several roles. A categorisation of roles includes:

- Clients / beneficiaries;
- Drivers / initiators;
- Executive agents;
- Decision-makers;
- Brokers / facilitators;
- Veto-players.

Finally, additional components of a higher education innovation system may be found in the regulatory and legislative activity of governments which shape the innovation system. As an example, the Californian government recently introduced legislation that requires public colleges and universities to grant credits to students who take courses online in the event that they are not able to sign up to regular classes because these are oversubscribed (New York Times, 2013). In a similar fashion, Dutch higher education institutions were prompted to develop tools such as Learning Analytics as a consequence of, among others, the 'government's pressure to report their success rates and performance' (Open Educational Resources Special Interest Group 2013: 98) and because of their performance agreements signed with the Ministry of Education, Culture and Science (ibid.).

2.3.3 Relationships among system components

The relationships among system components primarily focus on how innovation affects the way actors of higher education systems interact and perceive each other. The nature of the relationships between components of the system can be financial (e.g. how much does a given initiative cost for an institution? What is the expected return? As well as non-financial (e.g. does an institution gain in status and prestige? Do particular academics and/or departments emerge as winners and others as losers?). Three broad types of relationships are identified:

First, **collaboration and collaborative leadership** (led for instance by an Innovation Organizer) entails several processes (bottom-up and top-down) carried out in a collaborative fashion by different stakeholders (individual and institutional actors) drawn from different spheres. 'Mode 2 of science production' places collaboration with external organisations at the centre of the knowledge production function of universities (Gibbons et al., 1994; Nowotny et al., 2001), while the 'triple helix' of university, business and the state (Etzkowitz and Leydesdorff, 2000) brings the university as a key player in innovation to the fore, on par with industry and government. Innovation often requires new forms of collaboration which may sometimes be blocked by the competitiveness inherent to market-led forces (Hazelkorn, 2011), therefore a good balance between collaboration and competitiveness is essential for good relationships between institutions and the individuals.

Collaborative leadership can be very effective in **conflict moderation** between innovation actors, who may sometimes have a conflicting relationship, for instance if innovation triggers a divide between junior and senior staff, or ivory-tower and entrepreneurial academics, etc. Organizational innovation and cross-functional collaboration literature identifies two key types of conflict: (i) task conflict, which is content-driven and is generated by differences of opinions of an organization's functional departments about particular tasks (Amason and Sapienza, 1997); and (ii) relationship conflict, which is person-driven and is generated by incompatibilities or clashes between different personalities in different departments, leading to negative feelings such as tension and frustration (Jehn and Mannix, 2001; Finkelstein and Mooney, 2003). Task conflict has been shown to play a positive role in innovation by leading to a reconsideration of dominant perspectives and beliefs in an organization and stimulate original and divergent viewpoints (Van Dyne and Saavedra, 1996), while relationship conflict has a negative effect on the high-quality knowledge exchanges and decision-making (Amason, 1996; Jehn, 1995; Jehn and Mannix, 2001; Pelled et al., 1999).

Secondly, **substitution** arises when one institutional actor takes the lead on a function traditionally belonging to a different actor. For instance this occurs when higher education institutions, in addition to their teaching and research activities, engage in technology transfer and firm formation, providing support and even funding to encourage entrepreneurial ventures, thus enacting some of the traditional role of industry. Industry can also display substitution by taking the role of the university in developing proprietary education and training solutions, often at the same high level as universities (see for example, Pixar University, Intel Educator Academy, Cisco Networking Academy or Apple University). Government agencies can also display substitution when they take up, in addition to their traditional function of regulation and control, that of investment and provision of public venture capital - a traditional task for the industry sphere (e.g. Huggins, 2008; Gebhardt, 2012).

Thirdly, **networking,** as a manifestation specific to the increasingly collective nature of science, technology and innovation, is also relevant in higher education systems. The aggregation may be stronger or weaker, depending on the network's age, scope, membership, activities and visibility in the public domain (e.g. the Association of University Technology Managers (AUTM), the European Technology Platforms and the Joint Technology Initiatives, to mention just a few examples[6]). Research networks in academia have become comparable to a 'joint venture', whose stability appears to be of critical importance socially, politically and economically, in order to generate a particular division of labour among the participants (David, et al. 1999). Recent research suggests that the academic profession today exerts

[6] The European Technology Platforms (ETPs) are industry-led multinational networks (36 ETPs in 2011) of various stakeholders who define a common vision and implement a medium- to long-term Strategic Research Agenda in key industrial areas for Europe's competitiveness and economic growth (http://cordis.europa.eu/technology-platforms/). The ETPs have provided major input to European research programmes such as FP7, and some have been involved in the establishment of the Joint Technology Initiatives (JTIs), a form of long-term public-private partnerships that combine private sector investment and/or national and European public funding (five JTIs in 2011) (http://cordis.europa.eu/fp7/jtis/).

much of its power through cross-institutional networks and national and international organisations, which set the frameworks in which individual institutions must operate (Bleiklie et al., 2011). Academics in particular often value memberships and relationships within cross-institutional networks more than those within their employing organisation. Also, more senior academic staff often exerts more power and authority through external (national and international) organisations and networks than through their employing organisation (Bleiklie et al., 2011). Students' network relationships are often shaped by age and social class, as well as by the 'distance from home', i.e. living at home or having 'gone away' to study. For the former, pre-university relationships and networks are maintained, while for the latter, new relationships and networks are formed and social capital acquired, as past identities and relationships may fade away. Networking reflects the growing non-linearity and interactivity of innovation processes (Kaufmann and Tödtling, 2001) and provides several benefits[7] (Steinmueller, 1994). These relationships are important as they reflect change-inducing, evolutionary social and economic mechanisms at work in higher education interactions.

Overall, using an innovation system approach serves two main purposes:

- Moving beyond higher education as a broad category and looking into single elements that compose it (components, relationships and functions). This will allow us to pinpoint exactly why, how, and what innovation takes place and who are the actors that drive (or hinder) innovation;
- Taking a dynamic approach, by looking not only at innovation within the elements described above, but also at the interaction within and among components, relationships, and functions.

[7] For example, increasing network value with higher number of participants, reduction of research projects overlapping through network centralisation, complementary investments for information dissemination that may lead to economic benefits and easier access to information flows within the network by governments and firms, increasing their choices about specialisation, co-operation and competition (Steinmueller, 1994).

3. The changing landscape of teaching and learning in higher education

The three thematic chapters (chapters 3 to 5) are organised according to the same structure. Each chapter comprises: an introductory review of relevant thematic literature, highlights drawn from the case studies related to each of the themes, and a list of findings that emerge from the literature and the case studies and that are deemed relevant for (mostly) higher education institutions and policy-makers in achieving successful innovations in each of the thematic areas that have been identified.

3.1 Overview

Teaching and learning in higher education have experienced various innovative practices, with varying degrees of reliance on technological advancements, in order to, among other aims, increase student engagement rates, improve learning outcomes, diversify choice of subjects and increase flexibility in terms of delivery (time/place). Novel approaches include: (i) a movement to online learning technologies, (ii) blended learning (i.e. the combination of 'traditional learning' and online learning), both at course level and programme level, and (iii) innovative practices in teaching and learning not reliant on technology, such as student-centred and project-based learning.

Online education

The delivery of online education can take the form of an adjunct model (the use of ICT to enhance traditional face-to-face or distance learning), a mixed model (a significant portion of the course is offered online) and a completely online mode (ICT is the primary teaching medium). Online learning has developed further thanks to significant technological advancements and the increasing demand of students, with distance education providing more access to learning (Taylor and Newton, 2013). Many institutions are now exploring online learning technologies, which range from electronic books and learning materials, podcasting, blended learning to full online delivery of courses. In online education, the rapid growth of MOOCs is particularly relevant. While still relatively limited, the literature on MOOCs offers some insights as to how they are developing and their possible impact on the higher education sector. It is also important to emphasise that MOOCs as an innovative phenomena are evolving rapidly. In the brief time since collection of the case study data was completed one of the European MOOCs, Futurelearn has now released its first public courses. At the same time one of the United States' case study MOOCs, Udacity has signalled an important change of direction with the introduction of fee charging courses that provide tutor support[8], a development that appears to make this kind of MOOC closer to the online provision offered by many conventional universities.

Two strands of MOOCs have been identified, the so-called constructivist cMOOCs and the more traditional xMOOCs (Siemens, 2012). The cMOOCs model emphasizes 'creation, creativity, autonomy, and social networked learning', while the xMOOCs model emphasizes 'a more traditional learning approach through video presentations and short quizzes and testing'

[8] https://www.udacity.com/success. It is interesting to note that the Udacity website now distinguishes between courseware and courses "The difference between enrolling in a course versus viewing free courseware is like the difference between attending a great class versus simply reading a textbook".

(Siemens, 2012). It is the latter, xMOOCs that have gained considerable public attention. However, it would be a mistake to assume that all xMOOCs adopt the same approach; clear differences between the main providers can be identified (Armstrong, 2012). While MOOCs have stimulated considerable interest and debate and potentially may make a very significant impact, it is too early to say whether they should be considered 'game changers' for higher education (UUK, 2013). Some writing appears to suggest that MOOCs are a completely new phenomenon; however we would argue that MOOCs need to be understood within the context of both the growth of Open and Distance Education[9] and developments around OER and Open Courseware[10]. All these initiatives have rather long histories and suggest that the MOOCs also have a component of 'building on and improving existing things'. In focussing on MOOCs in this study we are not seeking to diminish the significant and increasing role of Open and Distance Education and Blended learning or to suggest that MOOCs offer a template for future development (it is far too early to make any such assessment) but we do believe the challenges offered by MOOCs to current educational systems deserves close attention.

A final introductory note on MOOCs has to do with the research agenda that couples the teaching and learning function carried out by MOOCs. For edX, an xMOOC, it is a key objective to '[…] go beyond offering courses and content. We are committed to do research that will allow us to understand how students learn, how technology can transform learning, and the ways teachers teach on campus and beyond' (edX, 2013). Similar views are also expressed at Stanford, 'Our first and foremost goal in exploring the potential of these technologies is to improve the education we offer to our own students.' (Etchemendy, quoted in Johnston, 2013). An evaluation report from Edinburgh University identified as a spinoff from their MOOC involvement 'a lively internal debate about pedagogy, online learning and costs/benefits of university education' (Edinburgh, 2013).

Blended learning

Blended learning is the effective integration of traditional face-to-face instruction and online learning approaches, which can be implemented as a transformative solution to problems with student learning and to organizational and institutional needs within higher education (De George-Walker and Keeffe, 2010). In other words, blended learning is the 'fundamental reconceptualization and reorganization of the teaching and learning dynamic' (Garrison and Kanuka 2004:97), not simply the addition of an approach to the existing structure (face-to-face or fully Internet-based learning). The effective integration of the two can lead to a significant shift of the nature and quality of education.

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[9] Distance Education has a long history. The University of London International Programme for example, celebrated 150 years of existence in the same year that the term MOOC was coined (Kenyon-Jones and Letters, 2008). The growth and expansion of the so-called "mega-universities" as a world-wide phenomenon has been well documented (Daniel, 1998). There has been considerable analysis of many aspects of these institutions including the costs and economics of distance learning (Rumble, 2001), the use of Technologies (Bates, 1995; Mason and Kaye, 1989) and pedagogy and student support (Simpson and Simpson, 2002).

[10] A second influence is that of Open Educational Resources (OERs), Learning Objects and more generally Open Access Publishing. Related developments such as iTunesU have been significant. The MIT Open Courseware Project (MIT, 2002) aims to make available educational materials from its courses openly available to anyone anywhere. This approach has also been taken up extensively elsewhere. The Open Education database lists courseware projects from around the world (OEDB, 2013) and the importance of Open Education and Open Educational resources has been widely recognised (Cape Town, 2007). The Open Courseware project influenced later MOOC developments from MIT, as did the Stanford online projects impact on Coursera.

Blended learning is often implemented as a response to increasing class size and student dissatisfaction with their learning experiences (Garrison and Vaughan 2013). Student engagement with and perception of blended learning has been widely discussed; there is a significant correlation between positive perception and higher grades. High achievers were more satisfied with blended learning courses and found them more engaging and convenient (Owsten, et al., 2013). Owsten, et al., (2013) believe this may be because lower achieving students may not be able to cope with the blended learning environment as well as their peers. Blended learning may create an advantage over face-to-face education (Garrison and Vaughan 2013:24). Blended learning has a salient impact on the development of skills for its participants, including 'flexibility, reflection, interpersonal and teamwork skill development, motivation […]' (Garrison and Kanuka 2004: 98), as well as a recorded increase in efficiency and convenience for students and faculty. Blended learning can also encourage transformative institutional change.

A closely related concept is macro-level blended learning, combining the traditional face-to-face learning with online learning possibilities at programme level: one course is provided completely online, the other face-to-face. Macro-level blended learning minimises the dangers of social isolation sometimes associated with e-learning (Rühl, 2010). Successful blended learning programmes have been developed by individual universities or consortia and these offer well regarded degrees and qualifications, such as the EuroMBA-Programme[11].

As the technological means are readily available, Garrison and Vaughan (2013) find that sustained collaborative leadership is crucial for successful implementation of blended learning. The development of blended learning entails several steps: the creation of a formal approach to policy and operations which support blended learning, strategic and operational planning, the correct assessment of resources, scheduling of courses, and the provision of support to faculty and student participants (Garrison and Kanuka 2004).

Innovative practices in teaching and learning not reliant on online technology

Many innovations in traditional forms of learning are not dependent on the employment of technology. Examples of such approaches include Student-centred learning (SCL) and Problem-based learning (PBL). SCL focuses on the needs of the student, rather than those of other actors in the education process, like teachers. This may include allowing students to determine learning strategies and learning speed (Di Napoli, 2004), with direct implications for the flexibility of the curriculum, course content and interactivity in the educational process (Attard et al., 2010). Examples of this include team learning, problem-based learning, and student self- regulated learning (Attard et al., 2010). PBL is a variety of enquiry-based learning that uses real-world problems and centres on learning through solving these complex problems to promote knowledge, acquisition and collaborative learning. There is no one form or model of PBL that promotes a single and specific type of teaching; PBL was developed at McMaster Medical School in the 1960s as a way to help students master critical problem solving. The approach was soon adopted by other institutions, who interpreted it to fit with their subjects and curricula, creating forms of PBL like hybrid PBL, traditional course and course-by-course models (Major and Palmer 2001). PBL improves student engagement and

[11] Further information on the EuroMBA can be obtained at: http://www2.euromba.org/

helps develop generic skills, though no significant effect on grades has been recorded (Major and Palmer, 2001; Allen et al, 2006).

3.1.1. The challenges driving innovation in teaching and learning

The increasing development and use of online education has been consistently driven by a mix of the various challenges outlined at the beginning of this report, namely the changing supply of and demand for higher education, the pressures from globalization, and changes in funding. Innovative practices that rely less on technology on a larger scale, such as blended learning and problem-based learning, are driven primarily by changes in supply of and demand for higher education. These challenges are discussed below with specific reference to innovative teaching and learning.

Challenges in online education

Large scale online education has become an important element in the higher education sector. The development of online education and of MOOCs, in particular, is driven by the possibilities of opening up higher education on a global scale (Koller, 2012). The significant numbers of students attracted to MOOCs to date certainly reinforce this aspiration. The geographical distribution of these early adopters also provides evidence of their global reach: as of today, Coursera alone has 5,625,302[12] registered students[13] from over 200 different countries, although it is open to question as to the extent they have so far succeeded in 'opening up' higher education. MOOCs have also been driven by the competitive pressures exerted by the globalisation processes. A recent Institute for Public Policy Research (IPPR) report (Barber et al., 2013) sees MOOCs as a key element in the unbundling of higher education, whereby 'the models of higher education that marched triumphantly across the globe in the second half of the 20th century are broken' (Barber et al., 2013) and globalisation and the impact of technology will threaten many aspects of conventional universities, enabling the unbundling of key components that can then be 're-bundled' subject to market competition and offered by a variety of different providers. It is not only the globalisation processes; however, that drives the rise of MOOCs. In order to understand the MOOCs, it is also crucial to keep in the framework of analysis the changing demand for higher education, notably the changing characteristics and objectives of learners. For instance, MOOCs may be more relevant to lifelong learning agendas than to initial post-school higher education. Also, learners may not always be motivated by the need for academic credentials (e.g. over 30% of students who studied at the UK Open University already held degree qualifications and were often not interested in adding more to them hence, the low completion rates.)

Challenges in blended learning

Blended learning is often employed in response to rapid growth, the desire to give access to more students, lack of physical infrastructure, or the desire for increased flexibility for faculty and students (Graham et al, 2013). Blended learning is also faced with several institutional challenges, including policy, resource, action plans, and faculty support (Garrison and

[12] The number of enrolled students changes on a daily basis. The figure is from the Coursera website (https://www.coursera.org/), last accessed on 2nd of December 2013, at 11.33am

[13] However, questions have been raised about retention and dropout. Jordan's analysis suggests that most MOOCs have a completion rate of less than 10%, while Feldstein gives an overall figure of 7.6%, calculating from her data (Jordan, 2013; Feldstein, 2013). Nevertheless, it has been suggested that traditional measures of retention for MOOCs may not be appropriate, as generally there are no academic consequences to non-completion (Feldstein, 2013).

Vaughan, 2013), all issues deriving from the implementation and development of blended learning. Garrison and Vaughan (2013) argue that with strong leadership and awareness-raising activities, many of the institutional challenges can be mitigated. Similarly, those engaging with blended learning (i.e. faculty members), should be advised and trained to ensure that technology does not become a barrier or challenge. The increased role of online learning increases the danger of students' disengagement with the course and the institution in general (the learning analytics case study highlights this issue to a large extent as well, see the University of Derby as an example). However, in mass and diverse higher education systems, levels and kinds of student engagement differ significantly, reflecting differences in external commitments (work and domestic) and in life stage and aspirations. Even within very traditional classroom-based education, there is often variation in the numbers of students who attend lectures.

Challenges for innovations in traditional forms of education

Drivers for innovation in traditional forms of education include institutional efforts being developed at European level (e.g. the renewed commitment for teaching styles like SCL and PBL as reiterated in the Bologna Process from 2009) and at a national level (e.g. in many countries, SCL has been repositioned as a significant way to widen participation in higher education). Beyond these institutionalized reaffirmations of new ways of learning, the recognition of the diversity among students and their optimal learning environment is driving salient changes in teaching and education; these adaptions of teaching and learning are customer-focused (Attard et al., 2010). Challenges for novel practices in traditional education, include optimizing its efficiency and effectiveness – PBL courses cover about 80% of the same curriculum compared to a conventional course in the same amount of time – and assessment procedures, as traditional methods (e.g. examinations) may not be appropriate for newer course structures (Major and Palmer 2001). Implementing PBL approaches can also be costly, both financially and in relation to time spent on preparation, teaching and assessment.

Opportunities and obstacles for institutions in responding to these challenges

While there are opportunities presented by these challenges for improving the quality of higher education and for extending access to it, there are also obstacles to be overcome deriving from the traditional internal structures of institutions of higher education. The relative autonomy of the institutional 'basic units' (Becher and Kogan, 1993) of departments and faculties within many higher education systems can limit the capacity for inter-disciplinary work and for the cross-institutional collaborations which this can require. The emphasis placed on the research function in many higher education institutions can limit the capacity for the initiation of successful innovations which concern education. There may be a lack of incentives to address challenges in addressing the latter compared with the career and institutional rewards to be gained from success in the former.

There are also dangers that the deployment of new learning technologies may encourage more passive learning among students. Thus, institutions face the challenge of providing active learning opportunities for their students and this may require changes in pedagogic methods. These are likely to include more collaborative learning – peer learning, social learning, personal inquiry learning – as well as opportunities for unstructured learning – brainstorming, meetings, conversations, and social media. Making knowledge and information available to students is just one aspect of the pedagogic process. Technology is an increasingly important part of the process but learning is its principal focus and outcome.

3.1.2 Actors, roles, institutional processes

Major actors in teaching and learning are the institutions providing higher education, faculty and staff and students. Institutional actors are more prominent in the implementation of online learning tools, as a notable change often occurs in strategy and collaboration at an institutional level; while teaching and learning will also be part of an institutional strategy and decision-making process, students and teachers are more salient actors in their implementation, interacting directly with, often even creating and designing, the learning process.

In many countries, the development of distance learning opportunities in the 1970s and the subsequent development of online learning possibilities by Open Universities were state-driven initiatives. More recent developments have, however, changed this landscape, and significant examples of online learning provisions can be found within **universities**, as for instance in the MOOC providers spun off from Stanford, who are embedded in the local entrepreneurial ecosystem and backed by private venture capital. In this respect, venture capital stands out as a notable feature of the business model adopted by some of key MOOC innovators, which may be a reason why MOOCs providers have been able to innovate and expand so quickly. There has also been a strong involvement from educational publishers and learning technology companies (Pearson, Blackboard). This can be seen as part of the ‘unbundling’ process outlined above (Barber, 2013).

On the other hand, **governments** can also be found as significant stakeholders in the development of such initiatives, as for example in the case of FutureLearn, where the UK government has signalled the strategic importance of MOOCs (Willets quoted in Olds, 2013) and the UK Prime Minister took representatives of FutureLearn on a trade mission to India (Inside Higher Ed, 2013b).

Faculty members are key actors in the development and implementation of new ways of teaching and learning. Faculty members have the opportunity to implement new ways of learning in the classroom, such as blended learning, problem-based learning, or other innovative methods; they act to facilitate the learning process, rather than solely providing knowledge (Hmelo-Silver, 2004). Bohle Carbonell et al (2013) argue that the full potential of faculty members should be used in implementing blended learning, starting from using their creative power to design and deliver courses using a bottom-up change process. This focus will allow programmes to better match the needs of the learner and teacher, build incentives in solving institutional bottlenecks and increase the creation of new knowledge in higher education institutions (Bohle Carbonell et al., 2013). The extent to which innovative possibilities are used in full depends often on the individual faculty members’ willingness to do so, as well as the responsiveness of the students to the new opportunities provided.

Innovative processes in teaching and learning are designed with **students** in mind, and in some cases, students can feed into the design of their learning experience. In relation to the latter point, Fraser and Bosanquet (2006) consider curricula to be dynamic processes in which the teacher and student can act as ‘co-constructors of knowledge’ (Fraser and Bosanquet 2006). The true degree in which students should or can participate is in part dependent on how staff engages with curricular development, staff experience and expertise or student availability to do so, coupled with the need to prepare and offer guidance to students (Bovill et al., 2009). Bovill et al. (2009) also recognize the limited research on student participation in curriculum design. MOOCs are also seeing an increased involvement of students: the cMOOC approach, where there is a dominant interest in 'building collective capabilities of the whole network', encompasses concepts of reward and personal status, providing students with the opportunity to develop their peer assessment skills (O'Toole, 2013: 5). Peer assessment can take many forms, including grading by peers, designating students as 'expert assessors', micro-feedback etc. Peer assessment practices have also extended to the evaluation of students' abilities outside of the classroom; MOOCs with a particularly diverse student group are well placed to offer this kind of assessment and feedback (O'Toole, 2013).

It has also to be recognised that a new generation of students is entering higher education and is bringing with it a new set of skills and expectations concerning learning processes and desired learning outcomes. These have implications for the roles and relationships between the learners and those who support the learners, whether through teaching, IT support, or in other ways. Expectations may also be changing concerning the content of learning, reflecting both changing labour market needs in terms of graduate jobs and, in many countries, the growing costs of higher education for the learners.

3.1.3. Open questions for the future of teaching and learning in higher education

Many of the question marks for the future of teaching and learning in higher education inevitably have to do with the extent to which online learning, and MOOCs in particular, will have an impact on the traditional structures of higher education. Even for those institutions which are not intending to engage with these new forms of education, there is the potential competitiveness which will come from this provision, with obvious implications for the levels of demand for the more traditional forms. While it is certainly too early to come to firm conclusions about outcomes and indeed the future of MOOCs, four themes (Jordan, 2013; Yuan 2013) appear of great relevance for the future:

- Sustainability;
- Pedagogy;
- Quality and completion rates;
- Assessment and credit.

The **sustainability** question has been raised by a number of commentators: how, given that MOOCs are 'free', can significant revenue be generated? We are now seeing the development of a number of potential approaches to developing revenue streams, particularly from Coursera (see also the analysis from Moody's on the potential impact particularly on the US higher education sector (Kedem, 2012)).

The debate about **pedagogy** is ongoing and is at the heart of the xMOOC/cMOOC distinction (Downes, 2013a). There have been criticisms of the pedagogic model of some Stanford MOOCs, but refreshingly they have shown themselves to be open and responsive to such challenges (Angrymath, 2012; Thrun, 2013).

Quality issues are gaining increased attention and in particular through the EFQUEL MOOC quality Project (EFQUEL, 2013). MOOC providers and participating institutions are developing appropriate quality mechanisms (Edinburgh, 2013).

Assessment and the awarding of credit, particularly though partnerships, is seen as a key route both to open up opportunity and to provide revenues streams. The recent partnership between Coursera and US state-wide institutions may be an indicator of this (Coursera, 2013).

3.2 Findings from the case studies related to teaching and learning

Four case studies examine the theme of innovation in teaching and learning: two case studies analyse the emergence and development of MOOCs in the US and in Europe respectively; the third is the case of the Olin College of Engineering that illustrates how a single new specialist institution with a broad, institution-wide innovation agenda in one professional area has developed its innovative curriculum and engagement with students; and the fourth is the case of the Bavarian Virtual University, which is a network of diverse higher education institutions within a particular region supporting cross-institutional collaboration and providing, through blended learning, new opportunities for students across all subjects.

A short summary of the case studies related to innovation in teaching and learning[14] is highlighted below, while the remainder of the chapter analyses the main points emerging from these cases.

Olin College of Engineering: this case study focuses on the approach to teaching and learning adopted at Olin. In particular, it provides an account of Olin's interdisciplinary curriculum that is built around the 'Olin Triangle', which includes studies in Science and Engineering, Business & Entrepreneurship, and Arts/Humanities/Social Sciences in collaboration with two neighbouring colleges, one specialised in Business (Babson College) and one in liberal arts (Wellesley Colleges). The aim of Olin is to produce graduates who have robust technical skills, the ability to apply engineering concepts to real problems, an interdisciplinary orientation and extensive design experience.

Bavaria Virtual University (BVU): this case study provides an example of education-focused cooperation between the state-funded universities in Bavaria. The BVU promotes and coordinates the development and implementation of tailor-made online course offerings at Bavarian universities for students (for free) and others (low fee). Online courses are developed according to 'blended learning at macro level', meaning that the course (micro-level) needs to be completely online so that it can be used in the study programmes of all universities. However, the BVU does not provide a complete online study programme: study programmes (macro-level) are therefore blended, as parts are traditional face-to-face courses and others are online courses.

US-originated MOOCs: the case study focuses on Coursera, Udacity and NovoEd, venture capital-backed education companies spun off from Stanford University offering online learning at low- or no- cost to thousands of students across the globe through

[14] Full case study monographs are available in an Annex to the report

partnerships with several universities. All are very young companies (Udacity was launched in January 2012, Coursera in April 2012 and NovoED in April 2013) and are founded by Stanford professors. All companies have a close connection with Stanford and the entrepreneurial and venture capital community of Silicon Valley, which had a key role in their creation and dynamic growth. The companies share a common belief in their role to bring accessible, affordable, engaging, and effective higher education to the world.

EU-originated MOOCs: the case study examines three initiatives at different stages of development. FutureLearn is a consortium-based MOOC model based mainly on UK universities supported by world-known UK institutions (British Council, British Library and British Museum) and the UK government. It is led by a not for-profit company owned by the UK's Open University, and has been formed as a UK response to large US MOOC providers, particularly Coursera, edX and Udacity. It has high-level political support from the UK Government. By contrast, in Germany, the two cases considered are niche providers with strong regional public sector and private sector support. OpenHPI is a development of Hasso Plattner Institute (HPI) based at the University of Potsdam in Germany. Leuphana is a public university in Northern Germany and it utilised the brand of the Leuphana Digital School as a platform for its online education In January 2013.

3.2.1 Why are innovative practices in teaching and learning put in place? An overview of challenges

The introduction of innovative forms of teaching and learning, be they online (e.g. the MOOCs), face-to-face (e.g. Olin) or a mix of the two (e.g. blended learning at BVU) has been a response to all of the challenges identified in this report: (i) the changing supply of and demand for higher education; (ii) changes in higher education funding; and (iii) pressures from globalisation processes.

The changing supply of and demand for higher education

Higher education institutions' reaction to the changing supply of and demand for higher education is most evident in all of the case studies. Supply-side developments are mainly new technologies that enable online learning through MOOCs and blended learning at BVU, and can impact the entire teaching and learning process, or only part of it.
Demand-side developments can be divided into three broad categories:

1) The changing needs and expectations of students, including lifelong learning, home-based learning and flexibility in the education career, together with the skills sets they have already acquired in the use of new learning technologies Online and blended learning are increasingly important ways of accommodating these changing needs of students and build on existing skills and expectations of a diverse population of students who may be expected to engage with higher education at several stages in their lives.
2) The changing needs and expectations of employers. Problem-based learning (used as a foundation stone for Olin's approach) is an example of an effort made by a higher education institution to build into its curriculum the ability to teach the practical skills demanded by the labour market, that it was felt they were previously lacking. The uncertainties and pace of change in the labour market are also important demand-side

factors. The labour market into which the student enters upon graduation may have changed dramatically after a few years. Can higher education equip the student to cope with the uncertainties of the future?

3) A further set of demands are likely to arise from the requirements of external governmental and regulatory bodies reflecting concerns about higher education as a provider of ‘public goods’ which may be defined in economic, social and/or cultural terms. In some countries, this is already creating an ‘impact agenda’ where the wider effects of higher education need to be recognised and, increasingly, to be measured. The flow of public funding into institutions may be strongly affected by the results of these measures.

Changes in higher education funding

This is a second major challenge that higher education institutions responded to by introducing innovative practices in teaching and learning, specifically the use of online learning environments. The provision of private high quality education, at free or low cost, to large numbers of students all over the world and widening access to higher education are main objective of the US and EU MOOCs, as well as the publicly provided provision of BVU. However, the expectations and demands of students may vary between an emphasis upon gaining qualifications, having a worthwhile educational experience (or an enjoyable one (!)), acquiring the skills needed to gain a good job, and much else. Different forms of higher education are likely to meet different expectations and demands. Some of the sources of income to institutions will be very contingent on how successfully these expectations and demands are being met. For many higher education institutions, therefore, a major challenge from changes in funding is the greater uncertainty about both the levels and the sources of future funding. In many national systems, funding is coming from a wider variety of sources, each bringing potentially changing and conflicting demands upon higher education.

Pressures from globalisation processes

Finally, globalisation is also a challenge that has led to the development of innovative forms of teaching and learning. Globalisation has brought with it a weakening of national higher education institution system boundaries, changing criteria of higher education excellence, and competition to recruit international students: MOOCs may be the perfect expression of this ‘disruptive enabler’, by facilitating the enrolment of tens of thousands of students from all over the world and strengthening the competition between higher education institutions even further. The impact of globalisation on the development of online learning platforms backed by the institutional commitment to attract foreign students emerges as a key principle behind the development of MOOCs both in the US and in Europe. For other forms of higher education provision, there is a need to recognise the greater degrees of international labour mobility, bringing with it a growth in the numbers of internationally mobile students and also a need for all students to receive an education which will be recognised as equipping them for careers within an increasingly global labour market. This might require greater institutional interaction across borders, greater collaboration along with the greater competition, and a need to take account of factors such as student demand, reputational opportunities and risks, research opportunities and the funding possibilities that come from all of these factors.

As indicated previously, the external challenges facing higher education institutions in responding to developments such as globalisation, changing demand and supply, and new funding arrangements, create internal challenges for institutions in terms of their structures and practices. We consider these below using the higher education innovation system framework.

3.2.2 Impact of teaching and learning innovative practices on the higher education innovation system functions, components and relationships between components

Impact on the higher education system functions

In section 2.3, we described three functions of a higher education system: education, research and service to society ('third mission'). The innovative teaching and learning initiatives described above impact primarily the education function of higher education institutions, but have the potential to spill over to the other higher education system functions as well, in the future. For example, online learning environments are also a test bed for research on the behaviour of online learners (as it emerges from the study of the US MOOCs, OpenHPI and Leuphana). Further, the establishment of online learning environments often require cooperation with entities outside the higher education sector strictly speaking, thus contributing to blurring the university boundaries and encouraging the development of 'third mission' activities.

Impact on higher education system components

As far as the components of a higher education system are concerned, the case studies (Table 4) show a variety of actors involved in the implementation of the initiatives:

Table 4: overview of actors identified in the case studies related to teaching and learning

Initiative	System components
US-MOOCs	Coursera, by far the largest of the three US MOOC providers, currently has over 80 university partners worldwide who use the Coursera platform to deliver their own MOOCs. Other key actors are software corporations, policy-making authorities, academics, Silicon Valley entrepreneurs and venture capitalists. There is a substantial Coursera team of 50 covering engineering, design, course operations, business development, administration and staffing, and this is set to expand substantially in the near future. Udacity partners include software corporations, policy-making authorities, academics, Silicon Valley entrepreneurs and venture capitalists. It has partnerships with other universities and with some major business corporations. NovoEd is a much smaller enterprise whose partner network is still in formation.
EU-MOOCs	FutureLearn has a long list of actors, including: FutureLearn Ltd, the Open University, other university partners, the British Council, the British Library, the British Museum, the UK Government, proctored examination companies, national regulatory bodies, students, academics and employers. However, the roles of many of these actors are currently unclear at this stage. The OpenHPI actors are senior staff of the Hasso Plattner Institute, the SAP-AG business management software company which provides funding, other HPI staff with relevant technological

	expertise, teaching assistants, professors, students and the state of Brandenburg. At Leuphana, students have key roles, working in small teams together internationally using a largely constructivist and connectivist pedagogy, along with Leuphana and other academics with relevant interests and expertise.
BVU	The following main actors are identified: the Bavarian Ministry, the 31 Bavarian universities, the staff of the universities, the BVU and its staff, students, and external experts in course evaluation. Online courses are developed within existing universities by their academic and technical staff and are then made available to students (and others) across the whole of the state.
Olin	While initiated by the endowment of the Foundation and the senior staff of the new college, Olin evolved rapidly into a very collaborative approach with a long list of current actors comprising students, graduates, faculty, administrators, employers, partner institutions and corporate sponsors. The case study report provides a detailed picture of the roles and relationships between the different actors and the strong emphasis on collaboration which these entail. It is interesting to note that the Foundation which established the college has now closed, and the funds and responsibilities have now been transferred to the college itself.

As it emerges clearly from the table above, all of the initiatives include a wide spectrum of actors, direct and indirect, individual and institutional, as summarised in the table below.

Table 5: summary of actors involved in teaching and learning

Actors	Direct	Indirect
Individual	• Students; • Academics; • Administrative staff.	• Venture capitalists; • Software developers; • Employers.
Institutional	• Universities; • Higher education funding councils; • Higher education quality insurance bodies.	• IT companies; • Private companies and foundations; • Regional and national governments.

Impact on the relationships between the higher education system components

At the individual level, all the innovative practices examined (online-learning, blended-learning and problem-based learning) suggest a more cooperative and horizontal relationship between the direct actors, notably academics and students. Students provide more inputs to tasks traditionally performed by academics (e.g. course design, as highlighted in the case of Olin, and peer assessment as in the MOOCs), while academics take part more directly of the learning experience of students, for instance by coaching and mentoring, rather than lecturing only.

At the institutional level, we observe intensified patterns of cooperation in all of the practices examined among direct and indirect actors, including: voluntary cooperation among higher education institutions; cooperation among higher education institutions initiated by the government; voluntary cooperation among higher education institutions and private companies. For example, the US MOOCs revealed on the one hand financially-driven new partnerships (with various external investors or with the partner universities) involving all the three platform providers and triggering the development of various internal monetization strategies that are currently experimented in each company, and on the other hand, non-financially driven new partnerships (e.g. between the platform providers and Stanford University, within the company institutional teams for advancing the company's strategic and organizational development, etc.).

Increasing cooperation appears thus a mechanism that is adopted to pool existing resources, acquire new resources, and share the risk and also some of the costs incurred by the implementation of innovative teaching and learning practices. Increasing cooperation does not contradict the increasing competition that we also noticed among higher education institutions, as discussed earlier. The two aspects coexist and manifest themselves as distinct individual and institutional responses at different levels and geographic or socio-economic contexts.

Relationships between individuals and institutions are also altered, as it was clear from some forms of conflict between the new and old forms of teaching, learning, university-faculty relationships, university-external technology providers, intellectual property rights, etc. A particularly relevant example in this sense, with the potential to generate even more important changes in the future, is the rise of 'star professors' and the emergence of new configurations of power and privileges top-tier professors may be given in their home higher education institutions vis-à-vis other academic staff, less successfully or not at all involved in online courses. This phenomenon was highlighted by the US MOOCs and was less visible in Europe.

3.2.3 Impact of contextual factors on the innovative teaching and learning practices

The analysis of contextual factors within which the innovative practices in teaching and learning examined here emerged, highlighted two main factors that influenced the shaping up of an innovative practice, namely institutional/regional level factors and systemic/national level institutional factors. The former refer to specific organisational features of a higher education institution interacting with its direct environment that enable the development of an innovative practice, while the latter refer to the broader systemic context descending from the political context within which a higher education institution is embedded.

Institutional factors are salient both in the US and EU MOOCs cases, which exemplify the importance of specific higher education institution's features in the development of an innovation practice, such as the institutional legacy of a university and its independence. For instance, Stanford's own history offers fertile ground for the development of online learning provisions, since these have always been part of the Stanford tradition. Indeed, the first attempts at developing online education date from the 1960s and determined a high degree of openness towards innovation through online teaching and learning that has always been part of the institution. Similarly, the EU MOOCs reveal that a long tradition of online learning within the Open University was a key motivation for the Open University to lead on the development of FutureLearn. Institutional independence also stems out as an important institutional feature that favours innovation. This aspect emerges as particularly relevant in the case of OpenHPI, which acts as a private institution within a public body. Innovations that spin off as the outcome of a favourable institution-level environment (be it the institution's independence, its long tradition in innovating, or a mix of the two) tend to start as bottom-up localised initiatives whose breadth may remain limited (e.g. the two German MOOCs examined) or develop into larger initiatives (e.g. courses being joined by over 80 higher education institutions) and attract institutional backing (e.g. the support received from the UK government by FutureLearn) or support from the private sector (e.g. Silicon Valley venture capitalists in the case of Stanford).

System or national-level factors have been highlighted by the BVU case, which appeared to be shaped by a significantly different context. Here, it is the systemic context that seems most relevant. The BVU is an example of a top-down initiative stemming out of a stable political context at the State level and a stable public funding that allowed a large consortium of universities to cooperate in the education sector. It is noteworthy that BVU is entirely government- funded and driven and it started off as a large cooperative initiative.

The interplay between institutional/regional and systemic/national factors actually reflects a continuum ranging between top-down and bottom-up approaches, as well as localised and large-scale innovations.

3.2.4 Outcomes and blockages of the teaching and learning innovative practices

The outcomes[15] of the teaching and learning initiatives analysed under this theme are very diverse, entailing:

- The extent of partnerships involved (e.g. large international partnership in the case of Coursera covering 83 associated higher education institutions, large national partnerships in the case of BVU and FutureLearn, localised initiatives in the case of OpenHPI, Olin, and Leuphana);
- The size of the student cohort (e.g. Coursera has over 4 million students, Olin 300)
- Course formats (e.g. entirely online for MOOCs, blended in the case of BVU, face-to-face at Olin);
- Course range (e.g. over 400 subjects in the case of Coursera, very specialised education in the case of engineering at Olin);
- Accreditation (e.g. standard accreditation measures in the case of Olin, a still not completely defined framework in the case of the MOOCs);
- Assessment (e.g. standard teacher's assessment in the case of BVU, peer-assessment in the case of the US MOOCs).

Despite the great diversity in outcomes to date, there are two general outcomes that are common to and cut across the different initiatives and are worth highlighting:

1) **The focus on a student-centred vision of teaching and learning**: all the initiatives assign a very central role to the student. For example, at Olin, students participate in the design of the curriculum and in Olin's specific approach of 'constructing knowledge'; in the

[15] Detailed facts and figures on each of the case studies are provided in the case study monographs

US-MOOCs peer assessment is a central component of the pedagogical model, thus assigning a role to students that goes beyond that of being a passive recipient of knowledge to actually participating actively in the learning process also through assessing their peers. Similarly, one of the BVU objectives is to provide students with more choice and flexibility, a feature common to the MOOCs initiatives as well. It is clear from the studies that while technology is a significant enabler of these initiatives, they are not driven by technology only. Rather, they develop through the vision and interaction of a range of actors seeking to address significant educational questions.

2) **The intense collaborative processes established within and beyond the higher education sector**: it has been observed that partnerships, networking and collaboration are optimal institutional set-ups through which innovative teaching and learning is delivered. This entails collaboration among higher education institutions (e.g. BVU, Olin, FutureLearn) as well as with other partners (e.g. private companies in the case of the MOOCs, regional government in the case of BVU). Collaborative relationships allow each partner to exploit each other's strengths and – strictly related to the previous point – meet the demands of an increasingly diverse body of students (or more broadly consumers) and employers.

Some blockages to a fully-fledged expansion of innovative practices in teaching and learning have been also observed. Again, moving beyond the specifics of each case study, two main issues emerge:

1) **Resistance to change at the institutional-level**: in several case studies, especially those largely driven by bottom-up initiatives, resistance to change was a notable phenomenon, as the innovations tend to change existing and established relationships among actors. In the case of Olin, an initial opposition on the side of academics to changing their role from lecturing to coaching and mentoring was observed. Similarly, a degree of scepticism towards online teaching and learning has been noted in our MOOCs case studies, a phenomenon that is also more broadly documented in other sources (e.g. Economist, 2013: 51). The resistance to the change induced by innovations and innovators within institutions is therefore a potential blockage that prevents the unfolding of innovative practices in teaching and learning at full potential, at least in the initial stages.
2) **Lack of appropriate regulatory frameworks at the macro-level**: this second blockage mostly applies to online learning. As a fast developing initiative, it has been noted that some online learning provision is not embedded in a suitable regulatory framework. Issues stemming from unclear quality assurance and recognition of credits are central elements which will need a solution at the macro-level (although piece meal legislations have been already been implemented in this respect, e.g. in California) in order to provide a stable and certain environment for both institutions and users of online learning. A similar line of argument runs for the regulation of intellectual property rights, which are not always clear at present.

3.3 Concluding remarks concerning innovative practices in teaching and learning

This section discussed how innovative ways of teaching and learning, be they online, forms of blended learning, or problem-based learning, are important tools that higher education institutions may resort to in order to address the overarching challenges of globalisation, changing supply of and demand for higher education, and changes in funding that have been identified. It has also been discussed how a fully-fledged development of these innovative practices, especially in the early stages, may be hampered by institution- and system- level blockages. Drawing on this discussion, the following recommendations appear to be relevant for a successful development of innovative teaching and learning.

At the level of higher education institutions, the following measures are recommended for consideration:

- Nurture an institutional culture to innovation that enhances creativity, creates awareness of the benefits resulting from the implementation of the innovation, stimulates openness to innovation and minimises resistance to change;
- Consider incentives and rewards for members of staff (including but not limited to academics) who engage in innovative practices;
- Engage faculty members in exploiting the potential of new learning technologies
- Consider the use of cross-institutional collaboration to improve student choice and quality (and possibly cut costs);
- Put in place adequate measures for skills development of teaching staff and also for greater collaboration in performing their teaching duties;
- Review existing organisational boundaries and linkages.

At the level of regional, national and supra-national policy-making institutions, the following measure is recommended for consideration:

- The establishment of a clear regulatory framework that addresses blockages that online learning is faced with today, namely: quality assurance mechanisms, credit recognition processes and intellectual property right regulations.

4. Improving student performance through technology

4.1 Overview

A major development in mapping and monitoring student performance in higher education is the use of tools such as Learning Analytics and Academic Analytics.

Learning Analytics is an important area for innovation and development in educational systems. Learning Analytics is in itself not a new research area; it builds on developments from a number of related fields and synthesizes several existing techniques (Chatti et al., 2012). The New Media Consortium (NMC) Horizon report (2013) identified Learning Analytics as a key emerging technology with a predicted widespread adoption in the next 2 to 3 years. The NMC report defines Learning Analytics as 'the field associated with deciphering trends and patterns from educational big data, or huge sets of student -related data, to further the advancement of a personalized, supportive system of higher education.' This definition identifies two key facets of Learning Analytics. First, there is the identification of trends and patterns from large datasets, and secondly, the use of this analysis to 'personalise' learning and support for students. It is important to emphasise that although Learning Analytics may be dealing with 'big' data, its output can impact at an individual level. Through the use of data and models to predict student progress and performance, institutions then have the ability to act on that information with the possibility, for example, of providing additional support to a student who otherwise may be at risk.

The development of Learning Analytics

Learning Analytics can be viewed as a specific example of application of analytics to the particular domain of learning and education. Broadly, analytics is defined as 'the use of data, statistical analysis, and explanatory and predictive models to gain insights and act on complex issues' (Bichsel, 2012). Many of the techniques used by Learning Analytics have been developed for business and commerce. Businesses employ analytics to gain insights from their customer data, to identify patterns of behaviour, to provide recommendations and to support advertising strategies.

When assessing in which context the use of Learning Analytics emerges, there is not a single set of factors that can be identified as preconditions. Even more, its emergence to date depends more on individuals and personal interests than institutional or regulatory policies. An essential precondition to develop a Learning Analytics system is the use of online learning platforms such as Blackboard or a MOOC environment. A close investigation is however needed to distil what kind of data can be obtained from these platforms and what data is needed for providing valuable feedback. Therefore, before being scaled and implemented top-down, the innovation focuses on detailed ground-work and continuous experimentation (trail-and-error) to identify what data is needed and how feedback should be provided to students.

Chatti et al. (2012) identify a range of fields that Learning Analytics draws upon. The first is Academic Analytics (Goldstein and Katz, 2005), which is used to describe the application of business intelligence tools and practices in higher education but at an institutional or systems level. Secondly, Learning Analytics draws heavily on data mining techniques, now widely used by government and business, more specifically on educational data mining methodologies (Romero and Ventura, 2007). A third area is that of the so-called 'recommender systems', which aggregate data about users' behaviour or preferences in order to draw conclusions for recommendation of items of relevance to the user. Such systems are widely used in E-commerce (e.g. Amazon) and in social networks (the 'like' feature). Recommender systems are used in some Learning Management Systems and library systems, but as Chatti et al. point out, there are open research questions over how algorithms and methods need to be adapted and optimized in order to be transferred successfully from the domain of commercial recommendations to Learning Analytics.

Learning Analytics and Academic Analytics

The relation between Learning Analytics and Academic Analytics is worth examining in more detail. Learning Analytics focuses on the learning process, while Academic Analytics reflects the role of institutional data analysis on student and institutional performance at an institutional, regional, national and international level (Siemens and Long, 2011). The distinction is an important one, as data collection for comparative purposes on educational institutions and systems is certainly not new, while the focus of Learning Analytics on the learning process, particularly as mediated through online technologies, does offer an innovative dimension and can potentially inform and influence key decisions made by students, academics and many other stakeholders. In so doing, it can also help to individualise experiences which are more collective in traditional educational settings.

Learning Analytics can be used to support relatively traditional models of teaching and learning, while enhancing their efficiency but they also have the potential to restructure the process of teaching, learning and administration, even though this possibility is still 'future focussed' (Siemens, 2010). Rather than the use of a uniform pre-planned curriculum as is generally the case now, 'learning content should be more like computation – a real-time rendering of learning resources and social suggestions based on the profile of a learner, her conceptual understanding of a subject, and her previous experience' (ibid.).

4.1.1 Challenges driving the use of technology to improve students' performance

The development of Learning Analytics lies at the intersection between the changing supply of and demand for higher education, and as well as the changes in funding structures and the pressure that higher education institutions have to find efficient ways of implementing traditional tasks. Three key issues identified by Ferguson (2012) are firmly grounded in such challenges.

With respect to supply-side challenges, the growth of 'big data' in educational systems has now become a reality. The development and widespread adoption of Virtual Learning Environments (VLEs) or Learning Management Systems (LMS) mean that educational institutions now potentially have large amounts of data, tracking and monitoring the performance of individual students and cohorts. VLEs do contain some tracking and reporting features, but it is only recently that system providers are beginning to explore the potential offered by their systems for Learning Analytics (Blackboard, 2012). To a considerable extent, the challenge now is to put to good use these 'big data'.

With respect to demand-side challenges, it has already been noted a tremendous growth of online learning. It is argued that Learning Analytics has a key role to play here, for instance

MOOC providers are using Learning Analytics approaches, such as recommender systems and peer review-based on crowd-sourcing techniques as part of their course provision to their students (Coursera, 2013). Issues related to student motivation and engagement with online learning (Simpson and Simpson, 2002) include how institutions and teachers can best monitor and indeed teach online, or how analytic techniques can be used to help teachers faced with perhaps hundreds of student responses in an online forum (Dringus and Ellis, 2005). In considering the challenges for more traditional educational settings, questions arise about how new data will inform and change key decisions and processes, alter relationships between key actors, and change fundamentally key elements in the learning experiences of all students.

With respect to the funding aspects, Learning Analytics represents a viable option to meet in an efficient way the increasing demand for educational institutions to measure, demonstrate and improve performance. In particular, demand side considerations also include the growing need and opportunities for students to make informed decisions about their choice of study, their approach to learning and their performance levels. These factors reflect the growing consumerist emphasis in many higher education systems and the shift from more teacher-centred to more student-centred arrangements. Further, students (both as learners and as consumers) are bringing increasingly developed skill sets and technological competencies with them when they enter higher education.

Alongside the opportunities for improving the performance and experiences of students which the new technologies provide comes a set of more internal challenges to be faced by institutions in changing their institutional practices and traditions to enable the opportunities to be achieved. These are addressed in the next sections.

4.1.2 Actors, roles, institutional processes

Learning Analytics has much to offer the **student**. In large-scale higher education systems, with many students enrolled in courses, it gives potential for greater individualisation, choice and diversity. Latour (2013) has summarised the benefits of Learning Analytics from a student perspective. It enables them to reflect on their own learning and on the learning of others, have a personalisation of the learning experience including content adaption, and facilitate learning at the student's own pace. In summary, Learning Analytics can provide insight to the student on their learning in the past to benefit learning in the future. To some extent, Learning Analytics may involve a transfer of power and decision-making away from the academic/institution to the student/consumer.

Through use of analytics, **teachers,** will be able to gain a much clearer example of student engagement and performance, even in large online systems. Wolff and Zdrahal (2012) report on a system developed at the British Open University that enables lecturers to track the individual performance of students through a sophisticated system of 'traffic light' indications, where a 'red light' indicates a lack of student engagement and possible problems. Dringus and Ellis (2005) show how teachers can better understand large online forums of postings by students. Furthermore, Learning Analytics should be seen in close relationship with Instructional Design[16], meaning that Learning Analytics practices should commence with clear ideas about the instructional practice and course design. Learning analytics therefore impacts

[16] http://lasiamsterdam.wordpress.com/resources/instructional-design/

the way teachers design there courses, as it becomes clear that students learn better when the course is designed differently.

Institutions can monitor the students' performance in terms of dropout and progression rates on a much more fine-grained level. They can thus evaluate their courses and improve outcomes for students (Greller and Drachsler, 2012). This will not be achieved simply by investing in the appropriate technology, rather a strong institutional commitment to implement processes and systems that will enable the institution to provide appropriate and effective support based on learning analytic insights is required. Siemens and Long (2011) point to the difficulties faced by administrators and decision-makers who are confronted with tremendous uncertainty in the face of budget cuts and global competition in higher education: 'Learning analytics can penetrate the fog of uncertainty around how to allocate resources, develop competitive advantages, and most important, improve the quality and value of the learning experience.' This does raise the possibility of the misuse of analytics: 'Data can easily be abused as supporting evidence for exercising inappropriate pressures on data subjects to change otherwise perfectly acceptable or explainable performance behaviour'(Greller and Drachsler, 2012).

Commercial organisations are key stakeholders in processes that potentially increase employability. It is worth noting that the University of Phoenix and other for-profit higher education institutions that emphasise employability consistently make use of artificial intelligence and predictive modelling techniques and that they have shaped their cultures around performance (Elias, 2011). Major LMS providers are now developing analytic features. For example, Blackboard Analytics is a suite of data warehousing and analytics products that supplies Academic and Learning Analytics (Blackboard, 2013). Another LMS provider, 'Desire to learn' is developing Student Success Stories (S3): 'The core of S3 is a flexible predictive modelling engine that uses machine intelligence and statistical techniques to identify at-risk students pre-emptively. S3 also provides a set of advanced data visualizations for reaching diagnostic insights and a case management tool for managing interventions' (Ellis, 2012). Knewton has developed a number of approaches ranging from the provision of Learning Analytics, then using these analytics to provide students with targeted recommendations and through to fully adaptive coursework for individual students. They are now partnering with major publishers to develop resources to support adaptive learning (Knewton, 2013).

Learning Analytics can be seen as an element in the 'unbundling' of higher education components (Shirky, 2012). The establishment of large data stores comprising performance data from huge cohorts of students potentially raises many issues in relation to their commercial use (Ravitch, 2013).

Government and regional organizations generally have an interest in Academic Analytics rather than Learning Analytics. Their concerns are with educational performance and general improvement measures, rather than a more fine-grained analysis of Learning Analytics. However, this distinction is by no means clear-cut. The ability of Learning Analytics to identify students at risk and potentially reduce dropout for example (Van Harmelen and Workman, 2013) and to enhance employability are clearly relevant.

The application of new technologies through approaches such as Learning Analytics has the potential to change relationships between the key actors within higher education, liberating some while constraining others. In some ways, it brings more business approaches to the work of higher education institutions, providing greater consumer choice and diversity. A major challenge may be whether these developments will tend to complement or rather replace the traditional professional authority of academics over the educational experiences of students.

4.1.3 Open questions for the future of using technology to improve student performance

As discussed in the previous chapter with respect to MOOCs, there are also a number of open questions that affect the future development of learning analytics (Ferguson, 2012), including:

- The connection with the learning sciences;
- A better understanding of learners' motivations and needs;
- The use of data within a clear framework of ethical guidelines.

How can we build strong connections with the learning sciences? This question is flagging up the important issue that while much of value may be imported from analytic work undertaken in the commercial field, Learning Analytics techniques and methods need to be fully grounded in understanding of learning and pedagogy: 'As Learning Analytics emerge from the wide fields of analytics and data mining, disambiguating themselves from academic analytics and EDM, researchers will need to build strong connections with the learning sciences' (Ferguson, 2012). Learning analytics will need to develop strong links with areas such as Learning Design (Laurillard 2012), and this process will be very much a 'two-way street', whereby the different domains support and enrich each other.

How can we better capture the motivations and the needs of learners? Learning Analytics can be extended beyond a concentration on questions such as grades and student retention to a more rounded perspective including enhancing motivation, developing confidence and meeting career goals: 'A focus on the perspectives of learners will be essential to the development of analytics related to their needs, rather than to the needs of institutions' (Ferguson, 2012). This wider perspective on Learning Analytics is more aligned to Siemens (2010) transformational view. In order for this to happen higher education institutions will need to provide the processes, tools, support and resources to help the teaching staff with the interpretation of analytic outcomes and with the further development of student focused resources.

How can we develop and apply a clear set of ethical guidelines? This issue revolves around the ownership and stewardship of data and the rights of learners. In the US there are specific concerns over recent legislation that enables organizations to accumulate and store personal, confidential data about every public school student. Critics argue that this has potential for undesirable exploitation (Ravitch, 2013), a concern that is widely shared. Ferguson (2012) argues for the need to create a clear ethical framework for the use of such data, in relation to students' responsibilities to act upon recommendations supplied by Learning Analytics, and for researchers to have clear ethical procedures in relation to the use of analytic data.

4.2 Findings from the case studies related to technology and student performance in higher education

Two case studies have explored this theme. The first encompasses the experiences of three universities (Purdue University, University of Amsterdam and Derby University) and focuses on the application of Learning Analytics to enhance student performance by providing better information to inform decision-making which can enhance learning. The second case study - the eAdvisor at Arizona State University, focuses on informing student choice of 'majors' and facilitating decisions which have important implications for student performance and learning outcomes. This second case study falls within the Learning Analytics as it also makes use of data to improve students' choice and ultimately contribute to increased retention rate.

A short summary of the case studies related to technology and student performance in higher education[17] is highlighted below, while the remainder of the chapter analyses the main points emerging from these cases.

Learning Analytics at Purdue University, the University of Derby, and the University of Amsterdam: This case study examines innovative approaches to the use of student data to inform decision-making by the use of Learning Analytics across three universities. The concrete examples which are:

- Purdue University (US) has implemented Course Signals to increase student success in the classroom. Purdue University's Course Signals application detects early warning signs and provides intervention to students who may not be performing to the best of their abilities before they reach a critical point. Course Signals is easy to use, it provides real-time, frequent and ongoing feedback. Furthermore, interventions start early - as early as the second week of class;
- The University of Derby (UK) explored the strategies to improve student enhancement processes by addressing key questions such as: (i) What is actually happening to students, how can we find out? (ii) What are the touch points between students and the institution? (iii) What are the institutional 'digital footprints' of the students? (iv) What really matters to students?;
- The Dutch University of Amsterdam (UvA) and the Free University of Amsterdam (VU) received a fund from SURF to conduct a pilot study on user requirements for Learning Analytics. It looked into ways to use data to make visualisations to inform teachers on (i) the use of e-learning material by students; (ii) the order in which the learning material is used; and (iii) whether there is a relationship between the number of materials used and the study results.

The eAdvisor at Arizona State University (ASU): The eAdvisor is Arizona State University's electronic advising and degree tracking system. It uses modern technology and data analytics to help students find majors that best fit their interests and thus ensure they have the highest likelihood to graduate. The key objectives of the initiative are to increase the student retention and graduation rate, provide quality education at affordable costs to an ever increasing number of students.

[17] Full case study monographs are available in Annex to the report

4.2.1 Why are innovative practices related to technology and student performance in higher education put in place? An overview of challenges

The answer to the 'why' question is closely related to two of the challenges identified in the literature: (i) the changing supply of and demand for higher education; and (ii) changes in higher education funding.

The changing supply of and demand for higher education

The Learning Analytics cases come as an institutional response to changing and diverse user/consumer (student) needs and expectations, and the consequent need for new approaches to maintaining and enhancing the quality of the student experience and performance. Also, one important aim of the eAdvisor is to improve completion rates, both to the benefit of the students themselves and to the benefit of the university in financial terms, due to the resulting increase in enrolments in later years of the course. While the focus of innovation is on the specific issue of achieving better informed student choices of 'majors', this is part of a larger 'quality improvement' agenda, involving not only increased retention rates, but improved student-centred learning processes, on-line advice and support, greater student freedom and choice of curriculum, greater employability and cost savings to the institution. These developments reflect both a growth in student 'consumerism' and a greater 'competitiveness' in the higher education 'marketplace'. Thus, there are both educational and commercial reasons for institutions to innovate in the ways in which they support and inform their students.

Changes in higher education funding

The quest to increase retention rates via innovative practices related to technology and student performance is in both cases (Learning Analytics and eAdvisor) also a response to changes in higher education funding. As already mentioned, increased retention rates are both beneficial for the student and for the institution.

The Learning Analytics cases and the eAdvisor are also a good illustration of the current and future challenges identified by Ferguson (2012): firstly, all cases struggle with dealing with the 'big data' available to track student performance. It is not a question of whether data is available, but of which data is best to use to support students. Secondly, Learning Analytics allows higher education institutions to better use the increasing volumes of online learning and to track student performance even when students are not physically present. Finally, Learning Analytics is used (or has the potential) to increase the efficiency in higher education.

Again, the innovation initiative meets challenges of implementation which need to be overcome if it is going to succeed. These are considered below.

4.2.2 Impact of technology and student performance practices on the higher education innovation system functions, components and relationships between components

Impact on the higher education system functions

All the case studies examined under this theme address the education function of the higher education system, but from different angles. For example, the Learning Analytics cases address the actual delivery of teaching and student-teacher interaction. There is a complaint raised in general (as mentioned in all three cases) that students, especially when entering university, are not accustomed to self-directed learning, perpetuated by a lack of personal interaction between student and teacher which they were familiar with in secondary education. Teachers do not have the time to get to know each student, let alone provide personal feedback on their progress made. This lack of interaction can result in a lack of engagement with learning, and insecurity on when students should start learning for their exams. Learning Analytics systems can help students to acquaint themselves with university life and become better self-directed learners. In addition, teachers can use the data to monitor student progress and track where they have difficulties grasping the material and by improving the course and their feedback to students, increase retention rates. In more advanced systems (e.g. Purdue), the Learning Analytics system is used to reflect on course structure and quality. As expressed by a faculty member, professors tend to get a bit lazy when it comes to reflecting on own course if they have been giving the course for years. The Learning Analytics system provides systematic feedback on what can be improved and what is difficult for students to grasp. Learning Analytics can in that sense be seen as a lesson in pedagogy for academics: in many countries, university teachers have never been taught in pedagogy and didactics.

The eAdvisor focuses on several other aspects of the education function: advising students on their learning trajectories and choices, by allowing students to choose the major that is best suited for them and providing warnings in case the student appears to be off-track; i.e. offering opportunities for course development, based on student feedback on various courses; and facilitating student mobility through a number of specific functions.

Impact on higher education system components

The most significant impact of the innovative practices is an intensified involvement of direct and individual actors at the institutional level within higher education institutions, such as students, academics (faculty members) and administrators / IT staff mostly and senior management. Other indirect actors (in the case of eAdvisor) include community colleges, foundations and private firms that provide funding to the initiative. The impact on the different stakeholders involved is a general widening of their perspective, blurring of institutional demarcation lines and through this a more differentiated pallet of activities. For instance, IT staff are involved in quality assurance, faculty are involved in defining criteria for progression.

In all cases, the presence of 'innovation champions' is noteworthy, in the sense of the impact of people who are committed to 'quality improvement', whether in terms of improved retention, better performance, new forms of (more self-directed) student engagement, or some combination of all three. In all three institutional examples, the emphasis is upon 'bottom-up' commitment and initiative in some cases supported by external organisations.

Impact on the relationships between the higher education system components

The most significant impact of the cases is an intensified participation of and cooperation among various different types of actors, institutional and individual, direct and indirect (students, academics, student support staff, IT support staff, policy-makers, etc.) as a prerequisite for success. Within the eAdvisor, collaboration with external bodies is aimed to provide financial support for the initiative and its implementation (for example, with the eAdvice service extended to community colleges and other institutions).

All cases are characterised by their interdisciplinary nature and blurring of responsibilities and lines of autonomy. The intensified cooperation impacts the activities of all individual actors. For instance, in relation to the Learning Analytics cases, the systems impact the course design and autonomy of the faculty: the analytics reveal weaknesses in the course, which the teacher can/ should take on board to improve the course. Another example is the IT staffs, which needs to develop sensitivity for how messages are received by students. It is one thing to develop the IT system behind it, but the communication-element is just as important. With regard to changing relationships, the following can be stated in relation to the eAdvisor:

- The eAdvisor facilitated the interaction between the student and the academic advisor in terms of the choice of a major, tracking student progress and finding solutions for the student in case of going off track;
- The eAdvisor facilitated the allocation of university facilities and instructors (e.g. number of seats and instructors for critical courses, cleaning of courses that are low in demand, etc.);
- The eAdvisor transfer of students facilitated the transfer of student records from the community college to Arizona State University. Any change in the student profile is immediately visible in the system.

4.2.3 Impact of contextual factors on the initiatives related to technology and student performance in higher education

When assessing the impact of contextual factors on the three Learning Analytics cases, it is interesting to note that several factors can be identified as preconditions. The emergence of Learning Analytics appeared to be more influenced by individuals and personal interests than by institutional or regulatory policies, on top of the essential precondition to use online learning platforms such as Blackboard or a MOOC platform. A close investigation is, however, needed to distil what kind of data can be obtained from these platforms and what data is needed for providing valuable feedback. Therefore, before being scaled and implemented more widely, the innovation is based on detailed ground-work and continuous experimentation (trial-and-error). At Purdue University, developments started very low-profile by a small group around John Campbell, an IT-interested academic. The work continued in the ITaP group (Information Technology at Purdue). In Amsterdam and Derby, subsidy programmes (respectively from SURF[18] and JISC[19]) were used to experiment with Learning Analytics at a small scale in an institution. Although these subsidies are rather modest, they created momentum within the institution that Learning Analytics is an interesting new phenomenon to work on. A common key contextual factor in all three Learning Analytics cases is that persons from different disciplines are involved early on: IT specialists, faculty staff, administrators and decision makers. The institutional context of the organisations enables these different stakeholders to cooperate by embedding innovation in the strategy of the higher education institution.

[18] http://www.surf.nl/
[19] http://www.jisc.ac.uk/

The outcomes of the Learning Analytics initiative will partly be shaped by local contextual circumstances or institutional mission. Thus, the British university with the strong emphasis on recruiting 'non-traditional' students has particular concerns about coping with diversity, with different forms of student engagement and motivation, identifying 'at risk' students. These factors have led to the concept of a 'customised data dashboard' to be developed to meet the diverse user needs. It takes a rather broader concept of the student experience than would be the case within different types of institution. Accordingly, this initiative can be relevant to the larger issues of higher education differentiation by providing institutions with the tools to achieve their own distinctive mission and to meet the increasingly diverse needs and circumstances of their students.

Similarly, also the eAdvisor is positioned in an institutional mission and vision. Arizona State University is one of the 'Next Gen U', which have been successfully utilising technology to improve learning and manage costs (Fishman, 2013) and made its mark as 'a hot-bed of data-driven experiments' (Parry, 2012). In his inaugural address in 2002, Arizona State University President Michael Crow stated the university's commitment to the success of each unique student as one of his primary goals. This goal has been pursued steadfastly, through expanding university access and graduating more college graduates with higher capacity to fuel the state's and the nation's economic engine. President Crow organised a team dedicated to transforming Arizona State University's vision from 'school-centred' to 'student-centred' and 'customized education,' led by Executive Vice President and Provost Elizabeth Phillips. The team focused on creating new programmes, personalised learning technologies, an online learning environment and innovative transfer partnerships to give Arizona State University students an educational experience focused on developing their talents and aptitudes and preparing them to graduate and enter the workforce or further their education (Arizona State University ASU Annual Report 2012).

To conclude, our case studies suggest that the success of technology-enabled innovative practices aimed to improve student performance does not depend on a particular regulatory or political context that favours the development of such initiatives, but it is rather related to the strength of the institutional support given to what usually starts as a bottom-up endeavour bringing together different institutional stakeholders, enhanced by top-down incentives provided via funding arrangement to subsidize small-scale experimentation before being scaled and implemented more widely within the institute.

4.2.4 Outcomes and blockages of practices related to technology and student performance in higher education

The outcomes of all cases studied show that data mining is used to build a more student-centred approach to education. Academics and educators mostly benefit from it by understanding better how students interact and relate to coursework, while students can access specific data tailored to their needs. Only at one of the three institutions does Learning Analytics appear to have become firmly embedded, with some quite impressive student performance improvements to report (Purdue University's Course Signals). A notion of 'actionable intelligence' available to different groups of actors within a larger 'quality improvement' vision appears to be coming firmly embedded. Course Signals appears to be particularly effective for first-year students to support them in becoming self-directed learners.

Research indicates that courses that implement Course Signals realize a strong increase in satisfactory grades, and a decrease in unsatisfactory grades and withdrawals (Arnold; Pistilli, 2012). According to the analysis of Arnold and Pistilli (2012), students report positive experiences with Course Signals overall. The computer-generated e-mails and warnings, shaped as personal messages seem to minimize their feelings of 'being just a number,' which is particularly common among first-semester students. Students also find the visual indicator of the traffic signal, combined with instructor communication, to be informative (they learn where to go to get help) and motivating. At the other institutions, the initiative seems to have more of a 'project' status, but in general there is evidence of positive changes in attitudes, behaviour and relationships across the institutions. Actors are both better informed and better motivated as a result.

In relation to the eAdvisor, concrete outcomes achieved to date are improved retention rates linked to increased revenue from larger student numbers. The eAdvisor is now also operating in community colleges in the region, thus extending opportunity and mobility more broadly beyond the university. At the managerial level, the eAdvisor makes an important contribution to improved performance and resource management within the institution. At the University of Florida, the eAdvisor resulted in a 20% increase in the graduation rate. At Arizona State University, the system has started to be implemented in the academic year 2008-9 and it has already resulted in an 8% improvement in the student retention rate, from 76% to 84%. With a first-year class of approximately 9,000 students, this increase is translated into an additional 720 students a year advancing from freshman to sophomore year, who otherwise might have dropped out (Arizona State University News, 2011). Each percentage point increase in the retention rate generates approximately $1.7 million in recurring increased revenues for Arizona State University, while greatly increasing the likelihood that those retained students will graduate (Phillips, 2013). The four-year graduation rate increased from 32% for the fall 2005 cohort (before the eAdvisor) to 42% for the most recent cohort (fall 2008) (Philips, 2013). After the introduction of the eAdvisor, students are much more on track and the quality of the academic advising has improved, with the academic advisors having better knowledge about the reasons for students going off track.

In terms of blockages, the most important ones reported in establishing Learning Analytics systems are listed below:

- Insufficient correlation between institutional and student data: institutional data and student data are stored in different 'silos' which do not communicate easily. Each department has its own data silo, online platforms store their data differently, administrative data are stored by central units and some data come from other sources;
- Data adequacy for establishing a student profile: The key question is not whether enough data is available, but what data are necessary to provide a risk profile of a student;
- Availability of skilled people and a shared vision: Learning Analytics requires a team of people with different backgrounds. A bottleneck is that the stakeholders might have slightly different ideas and objectives, and communicate in a different language. In addition, initiatives cross hierarchical institutional structures;
- Insufficient engagement of faculty staff: Initiatives need individuals who believe in Learning Analytics and early adopters among faculty staff. If these are absent, developments will not result in working systems. Convincing other faculty members remains difficult, even in advanced initiatives as at Purdue University. A reason for this is the implicit academic

attitude that a course belongs to the professor and that external interference in the course structure and quality is avoided. Teachers using Learning Analytics systems need to be trained, meaning that they need to be trained in being a teacher, willing to adapt the course to the specific needs of the students;
- Ethical questions on big data: Although currently not leading to difficulties, an issue which is becoming more and more important is the ethical question related to big data. On the one hand, institutions are required to use data to offer the best possible education; on the other hand, privacy laws might forbid them in using and linking different data silos.

The blockages in the development of the eAdvisor concerned the technical complexity of the online system, the need for permanent updates of the system with the related databases (e.g. national employment and salary statistics), low awareness of potential students on the requirements of academic life, choice of a major, etc.

4.3 Concluding remarks on technology and student performance in higher education

Innovation as something 'new' or something 'improved'? The case studies examined in this section are surely an example of the latter. All institutions collect data on their students, but what is collected and how it is managed differs considerably and this has major implications for whether and how it is used. The cases are therefore good examples of how to improve something which all higher education institutions already do to some extent. Nonetheless, this does not minimize the innovative or restructuring potential of the cases. The successful usage of a Learning Analytics system requires far more than the introduction of a new technology. A solid, 'trustworthy' Learning Analytics or advice system means major restructuring at all levels of the university, implying that:

- Teachers need to allow others to intervene in 'their' course design;
- IT departments need to convince staff and institutional policy officials to cooperate in order to build a comprehensive data system;
- Student administrations need to make student data accessible, though with ethical and privacy safeguards.

The innovation objectives addressed within the second theme are context-specific; therefore contexts must necessarily be taken into account in addressing how innovations are to be successfully achieved. The recommendations set out below, therefore, relate primarily to the institutional level, although there are also some which need to be addressed at national or regional levels.

At the institutional level, the following measures are recommended for consideration:

- The identification of the (diverse) needs and circumstances of the learners;
- Ensuring learner access to relevant technologies and possession of necessary skills to gain maximum benefits from them;
- Recognise that the successful introduction of learning analytics will be dependent not only on the choice of technology but on making the institutional changes necessary so that teachers, IT staff and administrators work effectively together to support students;
- Provide appropriate processes, tools and support activities so that Faculty are able

to fully utilise the rich data generated through analytics to enable them to respond to individual student needs and to further develop their teaching;
- Clarification of the roles of the different actors (within and beyond the institution) involved in meeting these needs;
- Ensuring a collective understanding of the different roles/responsibilities and the relationships between them;
- Ensuring clear lines of management responsibility and information requirements to assess performance;
- Building supportive relationships and trust between the relevant actors (students, academic staff, support staff, IT staff, managers and, where applicable, employers).

At the national or regional level, the following measures are recommended for consideration in those cases where innovations are being sought at the system level:

- Clarification of the funding implications, intended outcomes and timescales for the innovation;
- The collection and analysis of feedback information (from learners, institutions, employers etc.) on performance and impact, and the use of the information to inform all relevant actors;
- The identification of any unintended consequences of the innovation (e.g. for other functions, for widening participation or labour market linkages).

5. Globalisation and internationalisation strategies

5.1 Overview

Increasing globalisation has encouraged the development of a 'global' system of higher education On the one hand, it is characterized by its diversity, not by its uniformity (Maringe and Foskett, 2010); on the other, there is a pressure of conformity and homogeneity caused by the effect of systems of global ranking that employ standardising criteria. Internationalisation is an effect of globalisation; when considering the concepts of globalisation and internationalisation as they exist in higher education, it is important to note that they are not synonymous or categorically definable, but are interlinked (Teichler, 2009). Many scholars have defined these concepts, and note that they require constant updating and redefining in international debates. Broadly, globalisation refers to a wider process of increased economic activities between nations, which necessitates greater homogenization of fundamental aspects of life across different countries and the erosion of borders (De Wit 2011). Internationalisation is an important strategic and organizational means of responding to and absorbing the effects of globalisation. In the higher education field, internationalisation should be understood as a process which introduces new dimensions to and improves institutional quality and delivery of education, rather than a specific, linear goal (De Wit, 2011). This aligns with the process-based, and widely accepted, definition of internationalisation proposed by Knight (1994, as found in Knight, 2008): 'the process of integrating an international dimension into the research, teaching and services function of higher education', subsequently updated to 'the process of integrating an international, intercultural or global dimension into the purpose, functions or delivery of post-secondary education' (Knight, 2008).

Internationalisation and globalisation have become increasingly important at the European level since the 1980s, when they have become an indicator for quality in higher education. An increase of policy interest has also intensified the debate about the quality of internationalisation itself. It is also noted that internationalisation is not a homogenous process across Europe: internationalisation strategies 'are filtered and contextualised by the specific internal context of the university, the type of university, and how they are embedded nationally' (De Wit, 2010). These strategies are dependent on the type of education and programs that individual higher education institutions provides and are further deeply rooted in 'the normative and cultural insights, such as history and culture; academic disciplines and subjects; the higher education institution's profiles and individual initiatives; the national policy environment; regulatory frameworks; finance; European challenges and opportunities; and globalisation' (Frolich and Veiga, 2005).

While in many contexts, internationalisation is seen mainly in terms of the international mobility of students, for both educational and business reasons, more broadly it also entails increasing concerns about the comparability of qualifications acquired within different national systems, the internationalisation of the curriculum, the links with an increasingly internationalised labour market and the concerns of many institutions and academics to reference themselves against the supposedly 'best' and 'world class' universities.

5.1.1 Challenges driving the pursuit of internationalisation strategies

There are several specific challenges for internationalisation that are closely linked with the competitive pressures that globalisation processes exert on higher education institutions. These include institutional gains, public service or commercial/business/financial gains. In a non-exhaustive list, institutional gains can be found in the feeling of enhanced stature and breadth that ensues from attracting more, and higher quality staff and students, and in enhancing the existing curriculum or the acquisition of knowledge and language. A contribution to public services can be felt through a sense of increasing public good across or beyond borders (Friesen, 2013), while commercial or financial gain can be promoted through the development of a commercial advantage, contributing to overall profits or responding to demand (Altbach and Knight, 2007). Alongside these, simple survival is also suggested to be a primary driver of internationalisation, not just the pursuit of excellence (Chen et al., 2013). ICT and other forms of technology are considered salient supporting tools, but not a specific driver of internationalisation (Thune and Welle-Strand, 2009). Regardless of which rationalization strategies are used to justify institutional activities, there will be overarching benefits to internationalisation plans, which can include the plan acting as mechanism for explaining the goal of internationalisation, a medium for interdisciplinary collaboration, or a tool for fund-raising (Childress, 2009).

As well as providing a set of commercial drivers for innovation, internationalisation brings with it a set of educational challenges. These include the need to review existing curricula, their relevance and accessibility to learners from a wide range of backgrounds and with a possibly contrasting set of expectations and goals. These may result in a need to provide new kinds of learning support services as well as reviewing and adapting existing forms of pedagogy. Where local and international students are mixed and interact, there are significant opportunities for enhanced learning and personal development by students through these engagements, though these can also be accompanied by misunderstandings and conflict. Overall, there is a challenge to decide how much to adapt 'home' educational provision to meet the more diverse needs and expectations of international students and what it is most important to retain as the 'distinctiveness' of the educational offer. There can be both market and reputational consequences from how such challenges are met.

5.1.2 Actors, roles, institutional processes

Actors actively involved with the internationalisation of higher education include several levels of **government** (regional, national and supranational organizations, such as the EU), as well as an increasing role played by international and overseas actors. At the European level, the Union has enshrined education and training into its fundamental policies. Other EU level policies, such as mobility and cooperation between Member States, also impact the progression of internationalisation (Crowther et al., 2000). National governments still hold the most decisive power over issues of education, where, for example, parliaments pass higher education laws which directly impact on the entitlement and award of international degrees. Some European countries even decentralize the issue of education further, and award regional councils with extensive responsibilities within the education sector. In addition, with regard to overseas campuses, existence in a host country means that new authorities and regulatory bodies are involved. Overseas campuses are faced with far more complex structures of actors, which have direct impact on the institution's autonomy and market accountability (Crowther et al., 2000).

For **higher education institutions**, internationalisation has both a 'business' dimension – bringing in additional revenues from international student fees – and an academic/reputational dimension – from positions in rankings and league tables and the mobility of leading scholars. The latter concerns the research function in particular, with its implications for an institution's standing in an increasingly stratified higher education world, both nationally and internationally. International recognition brings local as well as international rewards, and enrichment of the diversity and interests, as well as career prospects of academic staff. The former concerns more the education function, though is not restricted to it. It includes mobility of study abroad, either for the whole of a student's higher education experience or for part of it, for example through schemes such as ERASMUS. The latter indicate an educational value to international mobility per se, as well supporting an increasingly internationalised labour market.

The institutional approach to internationalisation may involve a deep shift of the mission underpinning strategic plans of the higher education institutions undertaking these initiatives or may be a more superficial, ill-thought through attempt to expand market, sometimes with unintended and negative consequences. Strategic plans for internationalisation can encompass a variety of activities; specific initiatives for internationalisation can include 'branch campuses, cross-border collaborative agreements, [or] programs for international students' (Altbach and Knight, 2007).

These types of activities implementing internationalisation strategies exist along another dimension as well; Crowther et al. (2000) suggest that the institutionalisation process can encompass both home-based and overseas-based activities. Internationalisation 'at home' covers 'any internationally related activity with the exception of outbound students and staff mobility' (Crowther et al., 2000:6), as well as efforts to adapt curricula, teaching and learning. These efforts aim to help students develop intercultural skills and awareness. Internationalisation abroad focuses more on the development and provision of international education in a foreign country or cross-border education (Knight, 2008). In order to ensure an adequate response to globalisation, higher education institutions create internationalisation plans which delineate their strategic and organizational ambitions. Higher education institutions can rationalize their internationalisation strategies along the following axes: political (foreign policy, mutual understanding, national and regional identity etc.), economic (growth and competitiveness, labour markets, financial incentives etc.), social and cultural (role of the institution, participation and development of the individual within the changing landscape) and academic (development of international dimensions in research, institution building, prestige and status etc.) (De Wit, 2010).

Faculty members are key drivers and actors in the institutional process of internationalisation (Friesen, 2013). Faculty itself can be motivated by various issues such as intercultural experiences and intellectual expansion. Internationalisation strategies should not fail to recognise faculties, and should extend to including them in plans. Barriers to faculty participation include: lack of coordination and available information, constraints due to limited funding, disincentives to participation in international initiatives, lack of staff to facilitate the process (Dewey and Duff, 2009).

Students are important drivers of internationalisation; motives for studying abroad are varied, as are the outcomes. For students, there are the usual differences according to social and educational backgrounds as well as national differences. A recent study by Brooks and Waters (2011) reported that students who seek to study abroad are typically students who have failed to get places at their 'top' national universities and who decide to go overseas rather than go 'down-market' in their home higher education system. Thus, they may be looking essentially for status rather than education in their decision to study abroad. Universities have amplified their internationalisation strategies in response to globalising and increasing demand. Stromquist (2007) identifies universities' interest in student recruitment as a driving force in their internationalisation strategies, but notes that 'students from poorer regions such as those from Africa and many Latin American countries are not recruited' and universities have not adapted their curricula to global needs (Stromquist, 2007). Universities essentially offer the same courses they do to national students to international students, and may explicitly look for students with a command high enough to do so; though there is an increased interest in international students, universities have made limited steps in changing the educational experience for international students and creating truly international or global education. However, it can also be argued that internationalisation is not only 'study abroad'. Even for home-based students, there are challenges of preparation for lives to be lived in increasingly internationalised societies and economies.

5.1.3 Open questions for the future of internationalisation strategies

Internationalisation strategies pursued by higher education institutions are still confronted with a variety of issues, including the 'recognition of foreign diplomas and degrees, [and…] the recognition of credits and study periods abroad' (Van Damme, 2001), which suggests the need to develop and regulate quality control.

5.2 Findings from the case study related to globalisation and internationalisation strategies

One case study addresses this theme: the University of Nottingham, which has established campuses in Malaysia and China as part of a larger entrepreneurial transformation strategy for the whole university.

A short summary of the case study[20] is highlighted below, while the remainder of the chapter sheds light on the main issues raised by this case study.

> **The internationalisation strategy of the University of Nottingham (UK) and the establishment of campuses in Asia:** this case study analyses the internationalisation strategy of the University of Nottingham which started with plans to set up two international campuses in Malaysia and China, originating in the 1990s. This innovation is seen as part of deeper and wider institutional processes: the initiatives aimed not only to make Nottingham a global university, but to transform its identity, mission and ways of working from deeply conservative to vibrant, visionary and imaginative .The initiative is seen as 'deliberatively disruptive'. The overall objective of establishing the two Asian campuses, in Semenyih, Malaysia in 2000, and Ningbo, China in 2004, was to

[20] Full case study monographs are available in Annex to the report

create a different identity and stature for the university than could be won in the UK alone; to progressively embed an attitude of innovation and an international outlook throughout the university.

5.2.1 Why was the innovative practice put in place? An overview of challenges

This case study is a clear illustration of an institutional response to the challenge of globalisation. The initiative can be read as the attempt of the university to reap the potential benefits (e.g. enter new 'markets') and avoid potential threats (e.g. increasing competitive pressures at international level) posed by the globalisation process. This resulted in the strategy to think and develop globally rather than predominantly nationally and become a leading higher education player by internationalising. The strategy was materialised in the establishment of two Asian campuses, which allowed the university to position itself as a sector leader at a time when the whole UK higher education sector was looking for new business opportunities abroad. Going global opened up opportunities for competitive advantage and a new sense of identity and purpose less easily available in the constraining UK context. There was, thus, a mixture of commercial, reputational and educational challenges to be met by the form of internationalisation strategy being attempted here.

5.2.2 Impact of the globalisation and internationalisation practice on the higher education innovation system functions, components and relationships between components

Impact on the higher education innovation system functions

This practice was initially related to the education function of the university, which entailed retaining a campus-based teaching-learning approach called 'the Nottingham experience' and replicating it overseas, with considerable efforts in local staff recruitment and learning. The initiative soon impacted on the two other functions as well: the new campuses contributed to raising the university research profile (e.g. Marine Economy research at the Ningbo campus) and to a broader engagement with local stakeholders in Nottingham and in Asia, in a form of 'third mission' that was strictly linked with the teaching and learning experience. The 'third mission' element of the initiative is evident in the local business partnerships underpinning the development of both two overseas campuses and reflected in the choice of courses and curricula to be offered. It is also manifested in the increasingly deep and multi-faceted engagement with Nottingham City and the immediate wider region, especially in the Ningbo China development by joint overseas missions, as well as in the local socio-economic environment, as testified by the Editor of the local newspaper in Nottingham who has had a close experience of this evolution over twenty years.

Impact on higher education innovation system components

In terms of impact of the practice on the higher education system components, the initiative highlights the importance of a sustained top-down effort over a significant period of time by a powerful institutional leader who built up a strong team of management support to carry the initiative forward. Thus, an individual actor within the institution can be seen as the initiator of the internationalisation strategy. Externally, it received support from governments and private enterprises in all three of the national (and regional) contexts of the multi-national university. Staff and students were also important actors.

Impact on the relationships between higher education innovation system components

As an initiative which was intended to transform an entire university, the internationalisation strategy had increasing emphasis on people mobility and transfer. There are some indications that there has been change at the main Nottingham campus in the UK, and hence in the experiences of its students and staff located there. Change was not immediate, and there is mention of early opposition and indifference to the concept of 'export' of the Nottingham model to Asia, which had to be overcome. It was however clearly indicated that the institution's international profile has been a magnet for attracting high quality academic staff, and a shift from complacency to innovativeness in staff working practices took place. It was also indicated that the benefits of a change of profile and even identity were significantly shared by the City of Nottingham and the surrounding regional community, strengthening the city/region's capacity as a competitive regional economy as well as the university-city partnership.

5.2.3 Impact of contextual factors on the innovative practice

As with most innovative practices in higher education, one of the factors for success is that the innovation is embedded in the institutions' strategy. In the case of internationalisation, this is no different, the University of Nottingham maintains a long-term strategy in which internationalisation is strongly embedded. Besides this strategic orientation, two contextual factors played a key role in the realising the internationalisation strategy and implementing this innovative practice. First, the autonomy granted to public universities in the UK was an essential precondition for this sort of institutional vision, effectively comprising a single university – 'public' in one of its national contexts and 'private' in the other two. Secondly, the high reputation of the university, as well as of the various quality assurance bodies in the UK also played a determining role in the successful achievement of the internationalisation strategy and the navigation of foreign regulatory regimes.

5.2.4 Outcomes and blockages of the innovative practice

The concrete outcomes are two new international campuses that have established and have growing student populations – currently 4,500 in Malaysia and 5,500 in China, with realistic targets for growth that are steady rather than dramatic in coming years. The curriculum at the two new campuses has been evolving beyond the initial largely vocational emphasis and there is a clear intention to connect it with regional economic and other needs. There is also a clear intention to develop research and knowledge transfer functions, and several initiatives have already occurred, with new research centres created. There is also a new Doctoral Innovation Centre at the China campus with 100 PhD students dividing their time between China and the UK for their research on energy and digital enterprises.

Many of the potential blockages to the initiative were circumvented by the sustained leadership that the initiative enjoyed. These include the initial internal conservative resistance, as well as 'parochial' resistance and suspicion of motives in Malaysia and China, where high-level patronage was used successfully. Another potential blockage, i.e. that resulting from juggling relationships with three different governments in different political contexts, was avoided through sensitivity to local norms and practices. The Vice-Chancellor had a genuine interest in the history, culture and ways of the partner countries and became well versed in these before and while doing business. Thus, the only evident bottleneck was in the scale and cost of very senior management time needed for the thorough hands-on approach adopted. This was resolved by staying with just two campuses, and using other means for internationalising in other places and ways. The staffing and management of an international campus has presented particular challenges. IT limitations became evident with much enlarged scale and are being addressed in view of future developments in coming years.

5.3 Concluding remarks on globalisation and internationalisation strategies

From a narrower point of view, it could be argued that this theme is relevant to only a small proportion of higher education institutions – those possessing or aspiring to possess a global reach and brand. From a broader point of view, however, it can also be argued that the theme is relevant to a much larger proportion of higher education institutions, as globalisation is a general feature of the modern world and has implications for all higher education institutions. Below we make some general recommendations concerning innovations stimulated by globalisation and internationalisation in general, and then consider the particular case of multi-campus universities.

For innovations related to globalisation generally, the following measures are recommended for consideration by higher education institutions:

- Balancing between commercial, educational and reputational considerations in formulating their overall international strategy;
- Addressing a range of interconnected factors such as student mobility (inward and outward), student placements, qualification recognition, funding implications, curriculum and pedagogic implications, and labour market linkages;
- Considering the needs of different actors including home and international students, academic and support staff, quality assurance agencies, employers and sponsoring bodies.

In addition, where multi-campus innovations are involved, there is a need to consider a further set of measures:

- Engaging 'home' staff and to build relationships between staff located at the different campuses;
- How much to 'export' from the home institution and how much to build to reflect local contextual factors at different campuses;
- How much to 'import' from the international activities to reshape the home institution;
- How to satisfy different national regulatory and quality assurance regimes.

Policy-makers should in turn consider:

- Providing support for inward and outward mobility of students.

6. Conclusions

The main findings are structured around the four overarching questions of the study.

- What are the main challenges facing higher education and driving innovation in this sector?
- What are the key differences in terms of regional and institutional contexts for achieving successful innovation in higher education for different constituencies?
- How does innovation in higher education involve key system components and how does it influence – directly and indirectly – the system functions? What are the key processes and the roles of the key stakeholders in implementing innovation?
- What are the major outcomes of innovation in higher education and what bottlenecks and blockages exist in achieving them?

The findings draw on relevant literature on innovation in higher education and on the seven case studies. They need to be considered in the light of the fast-moving nature of the field, the time that innovation and change need to become embedded in institutions and systems, and the difficulty of predicting long-term outcomes of major innovations.

6.1. Main challenges driving innovation in the higher education sector

A review of literature on innovation in higher education revealed three main challenges facing higher education[21] across the globe and also driving innovation in the sector:

- Pressures from globalisation;
- Changing supply of and demand for higher education;
- Changes in higher education funding.

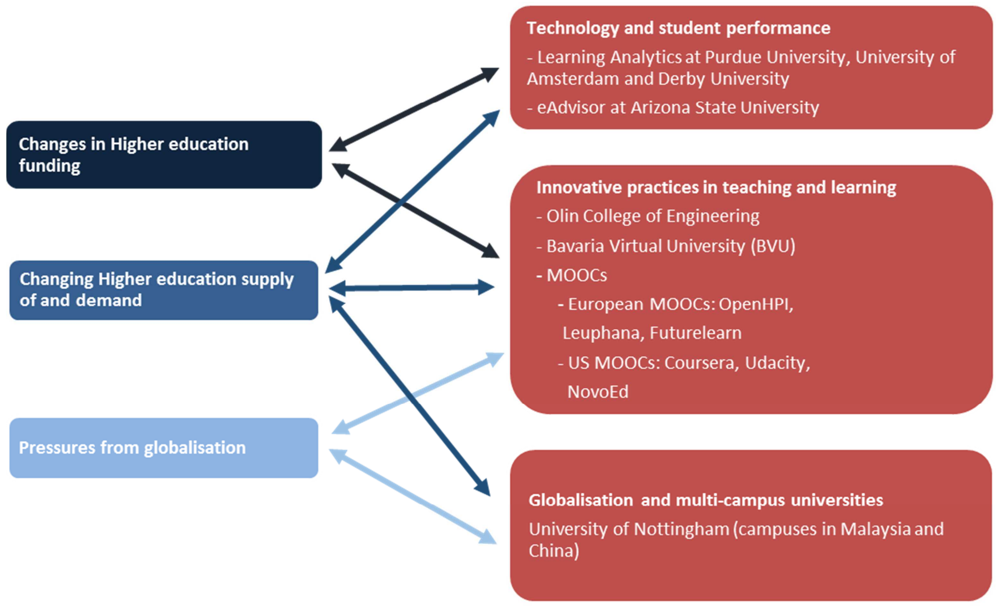
In response to the external challenges, various innovative practices in delivering the education function of higher education institutions have been developed around the world, some of which have been captured by the seven case studies conducted within our research. They have been grouped in three themes that reflect their various natures and that present several areas of overlap and interconnection:

- The changing landscape of teaching and learning in higher education;
- Technology and the student performance in higher education;
- Globalisation and multi-campus universities.

As the figure below illustrates, the same challenge may trigger different institutional responses, manifested by the introduction of different innovative practices at different higher education institutions. Conversely, the same innovative practice may be simultaneously driven by more than one challenge or respond to more than one challenge.

[21] It is not claimed that these are the only challenges facing higher education or that these challenges are exclusive to higher education. But they do constitute major challenges for higher education generated by a changing external environment. In turn, these create internal challenges for higher education institutions to change and adapt in order to meet the changing external requirements.

Figure 1: Challenges and innovative practices adopted to address them



Challenges from globalisation

Globalisation challenges are manifested on multiple planes. Politically and economically, there is an increasingly complex interplay of local, national and global factors that need to be carefully balanced, and a fierce international competition for markets, resources, technology and knowledge. In the higher education sector, there is a growing international mobility of labour and students, emergence of new institutional formats responding to new criteria of excellence and competitiveness, an increasing alignment of national policies, especially in such areas as quality assurance, qualifications and links to the labour market, to the global trends, as well as a strong competition to recruit international students and achieve global recognition for courses and qualifications in order to meet the labour market needs of all students. Many higher education institutions increase cross-border operations and seek to take best advantage of the new opportunities provided by the use of technology as a 'disruptive enabler'. Moreover, an increasing level of boundary crossing, within and beyond higher education institutions, as well as between higher education institutions and business providers of education, can be observed. This may be even more 'disruptive' than any new technologies, as new relationships are being formed, expectations and roles change, lines of authority can be radically altered and established practices may eventually be replaced by new ones. New private providers of higher education and new knowledge-intensive enterprises are entering territories previously dominated by mainly state-supported universities. This 'opening up' of knowledge societies poses both threats and opportunities for higher education. What is clear is that different higher education institutions respond to the challenges of globalisation in different ways, partly reflecting their different contexts and partly reflecting their different institutional aspirations and perceived opportunities.

Many of these features can be seen in our case studies. For example, the University of Nottingham has adopted an institution-wide internationalisation strategy aimed to transform it into a global university and strengthen its potential in the competition over foreign students. To realise this goal, two campuses in Asia (Malaysia and China) have been established, and their implementation has been considered to have successfully integrated national and international agendas, student and staff mobility, as well as educational, reputational and commercial institutional interests.

If some universities, like Nottingham, have adopted internationalisation and going overseas as a 'go out to the students' strategy, others have positioned themselves on the opposite trend of 'bringing the students in', by attracting students, regardless of their physical location, through e-learning as well as more traditional mechanisms of recruiting international students. The MOOCs are a clear example of this trend, with a rapid development in US, Europe and elsewhere. Coursera's vision of giving the possibility to 'anyone around the world', to 'learn without limits', accurately describes one of the most important missions of MOOC providers. The massive sign up figures provide evidence of the success of MOOCs in responding to previously unmet demand for higher education, although further work is required to understand the significance of the low completion rates. Overall, it is too early to judge what impact MOOCs will have on the rest of higher education.

Challenges from the changing supply of and demand for higher education

Today's supply-side developments in higher education frequently revolve around the use of technology as a means to improve students' performance and learning experience through new online teaching and learning methods and learning environments that developed alongside traditional ones and, in some instances, have started to replace them. The MOOCs and Learning Analytics case studies illustrate the changing landscape in the supply side of higher education from various angles, with different tools and approaches (e.g. implementation of Course Signals at Purdue University to increase student success in the classroom, introduction of the eAdvisor at Arizona State University to facilitate students' choice of a major and successful graduation, and development of different MOOC platforms by a range of providers, with different philosophies).The provision of 'blended learning' opportunities through the introduction of on-line alongside more traditional face-to-face teaching and learning is another developing practice, witnessed in the case studies by the Bavarian example.

On the demand side, changing needs of, and expectations from students and employers, as well as changing patterns of skills acquisition and lifelong learning, prompt higher education institutions to innovate. The case of the Olin College of Engineering shows how new ways of teaching and learning that move away from the traditional role of students as 'recipients' of knowledge into pro-active contributors to curriculum design and the learning process appear to have been beneficial in meeting employers' needs in a specific field – engineering – where graduates' lack of central skills was a recurrent problem. Similarly, the development of MOOCs is also an example of providing lifelong learning and home-based learning, driven by an ever increasing demand in this respect from both employees and employers. Therefore, different models of learning – active or passive, collaborative or individual – may be features of these different types of innovation.

Challenges from changes in higher education funding

Increasing education costs and declining funding, especially from public sources, have been key features for higher education in recent decades. They are at the centre of heated debates over the differentiated impact across institutions and disciplines, over beneficiaries of and contributors to higher education, over student attraction strategies and finding new ways of cutting costs or generating additional revenue, or both. Uncertainties and an increasing multiplicity of funding sources exacerbate the challenges for institutions.

Learning Analytics and the eAdvisor initiative at Arizona State University show how traditional functions of higher education institutions (e.g. mentoring and advising students) may be implemented differently and more cost-effectively through the use of technology. The MOOCs case studies show how e-learning is also impacted by changes in higher education funding, with the declared objective of several MOOC initiatives to provide low or no- cost education to large numbers of students. The implications for more traditional forms of higher education are still unclear at present.

Conclusion:
Three challenges emerge as particularly relevant in driving innovation in the higher education sector: (i) challenges from globalisation; (ii) challenges from the changing supply of and demand for higher education; and (iii) challenges from changes in higher education funding. These challenges are linked to deep changes not only at local, national and global levels, but also at the level of institutional organization, management, funding, interaction with business, government and other partners, education provision, content and delivery methods. These various challenges determine the development and implementation of various innovative practices to address them.

6.2. National / regional and institutional contexts for innovation

The contexts of the innovative practice differ in all the case studies and determine in what way the innovation is shaped and what the scope of the practice is. A distinction was made in the analysis between national/regional contexts and institutional contexts, which are seen in a close interplay:

- **The national/regional context includes factors applicable to all (or most) higher education institutions in a specific region or country.** Factors include the autonomy and decision-making powers of higher education institutions in a country or a region, funding sources, channels and amounts (e.g. the balance between public and private funding or between national and international funding sources, institutional vs. competitive funding, etc.), or the general higher education traditions in the country. Different parts of the world have different institutional traditions in terms of matters such as the power of the professor (the so-called 'professor's privileges'), mobility of students and staff, student learning and assessment, transmission of knowledge. All these factors may determine the success of an innovative practice, as they affect the entire life cycle of an innovative practice, from the starting point to its final stages;
- **The institutional context includes factors that influence the way a higher education institution is organised and functions.** Factors include the higher education institution's overall mission and the balance between its education, research and engagement missions, the scope of its commercial partnerships and orientation, its student population, staff, relationship with the regional labour market, etc. All these institutional factors affect the way innovative practices are to be achieved, as well as what innovative practices are needed and achievable in particular contexts. Institutional context factors are

equally important in achieving successful innovation practices as the broader national/regional contextual factors. Furthermore, institutional factors such as background and tradition, histories and strongly embedded organisational cultures also influence the balance and relationship between the education and the other university functions.

The most prominent contextual factors for success of the innovative practices examined in our case studies vary significantly, as illustrated in Table 6.

Table 6: summary of most prominent institutional and national/regional contextual factors by case study

Case study	Contextual factors
Olin College of Engineering (US)	**National/regional factors**: The recommendations of the National Science Foundation emerging from their study on the state of the art of engineering education in the US, provided a roadmap for the development of Olin College's innovative curriculum. **Institutional factors**: The individual initiative of FW Olin Foundation Director, who was keen to initiate a college that could address some of the major problems of engineering education in the US (i.e. not enough relevance of education to the labour market, not enough emphasis placed on problem-solving, too much theory over practice, and research over teaching). This individual dimension was coupled at the Foundation's institutional level with the financial contribution from the Foundation that allowed the Olin College to open.
Bavaria Virtual University (Germany)	**National/regional factors**: The Bavaria state funding given to all partner institutions (Freistaat Bayern); the political stability of the state of Bavaria, enabling a large project such as the BVU to mature. **Institutional factors**: The status of BVU as a state-funded, but state-independent, university-governed permanent organisation, which receives permanent funding from the state and does not depend on *una tantum* project-funding.
US-originated MOOCs	**National/regional factors**: The collaboration with the American Council on Education's College Credit Recommendation Service (ACE CREDIT) of both Coursera and Udacity for the evaluation and accreditation of a selection of their courses, the support of notable Silicon Valley venture capital firms that was essential for the set-up and growth of all three MOOC platform providers, a specific legal context for granting credit to MOOCs that is starting to take shape in California, Florida and other states. **Institutional factors**: Stanford University's strong

	institutional tradition for online learning that can be traced back to 1969, the close interaction between the university and the platform providers, the intellectual property rights agreements made between the higher education institution and the MOOC platform providers regarding course and material ownership, the common wish of all three platform providers to deliver high quality education, free or at low cost, to large numbers of students from all over the world, although their individual approaches to realising this objective varies from one case to another.
EU-originated MOOCs	**National factors**: The support of the UK government to FutureLearn, exemplified by its promotion of FutureLearn at the G8 summit. **Institutional factors**: Institutional tradition for online learning. This was identified as the largest motivation for the Open University to embark in the MOOC adventure and play a major role within FutureLearn. Similarly, Leuphana piggybacked its initiative on the Digital School that was already existing, also therefore embedding the development of the MOOCs into its own institutional tradition, albeit less long-standing than at Stanford or the Open University. Open Hasso-Plattner Institute developed its programme thanks to its institutional autonomy, granted by its status as public-private partnership. The collaboration between mainly state-funded institutions (FutureLearn) is also noteworthy here as an institutional factors for success
Learning Analytics at Purdue University (US), the University of Derby (UK), and the University of Amsterdam (the Netherlands)	**National factors:** No major contextual factors at national / regional level were identified. **Institutional factors:** Initiatives linked to the presence of 'early adopters' among the faculty who have an interest in the development of such initiative and that manage to embed it into the institution, strong role of the university internal institutional structures and willingness to enhance student performance, in the context of a move towards a student-centred vision of higher education.
The eAdvisor at Arizona State University (US)	**National/regional factors**: National effort to regain the world lead by increasing American degree attainment to 60% by 2020, introduced after President Obama's 2009 pledge; Arizona State University's affiliation to the 'Next Generation Universities' ('Next Gen U') that have embarked on the endeavour to introduce new innovative, cost-effective approaches to teaching and learning, especially using new ITs; Private funding of $1 million from the Kresge Foundation for the development of the e-Advisor transfer partnership component (which allows the transfer to Arizona State University of students from other higher education

	institutions, in particular the state community colleges), and another $1 million from another private investor for the development of the high school partnership component. **Institutional factors**: Arizona State University's innovative environment and student-centred education vision, the dedication of the institutional team in charge with the development and implementation of the e-Advisor, Arizona State University's status as the country's largest public university (74,000 students), and also Phoenix's only public university, with a very diverse student body, which makes it accountable to the tax payer and striving to achieve the best results for the funding it receives. Arizona State University's strong awareness of the social and economic impact of college graduates.
Internationalisation strategy of the University of Nottingham (UK) and the establishment of campuses in Asia	**National factors:** The high reputation of various quality assurance bodies in the UK and the autonomy granted to public universities in the UK were essential precondition for the internationalisation vision. **Institutional factors**: The high reputation of the university, strategic embedding of internationalisation and dedication of the management to implement the strategy.

The table above illustrates how the interplay between national/regional and institutional factors contributes to the development of the innovative practice examined in each case study and the further implementation/scaling of the practice. The prominence of one or another type of factors varies subject to various features. One such feature appears to be the scope of the innovative practice: the broader the scope, the higher the influence of national/regional factors; the more limited the scope, the higher the influence of institutional factors. Another feature is the autonomy of an institution and the balance between its bottom-up and top-down approaches to innovation. In general, more autonomous higher education institutions, having more control over their financial resources and allocation of these resources to their functions, tend to develop more bottom-up practices. The direct impact of these types of innovations may be more immediate, but also more limited, often confined to the boundaries of the innovating institution. On the other hand, less autonomous higher education institutions tend to have a more top-down, state-driven approach to innovation. This does not make them less innovative, but comes to support wider-ranging relationships and processes across the higher education system and longer timescales for implementation, ensuring a longer-term and larger impact beyond institutional boundaries.

The development of the Learning Analytics Course Signals system at Purdue University, the eAdvisor at Arizona State University and the internationalisation strategy of the University of Nottingham have in common a context where these institutions have a high level of autonomy and the innovation impact is limited to the particular institution. State-driven innovation is exemplified by the Bavarian Virtual University (Germany), where more than 30 state-funded universities cooperate to develop online-courses provided across the institutions' borders. The innovation is clearly a top-down initiative steered by state funds and the innovation impacts on the entire higher education system in the State of Bavaria.

Conclusion:
Successful innovative practices build on an interplay between national/regional and institutional factors that varies subject to the scope of the innovative practice, and the higher education institution's balance between bottom-up and top-down approaches to innovation.

6.3. The impact of innovation on the higher education system elements

The development and implementation of innovations in a higher education system have an impact on all the system elements: components, relationships and functions.

At the level of *components*, all the innovative practices discussed in this study appeared to have a broad impact, reaching out to the entire typology of actors identified in the analytical framework of the study, i.e. direct individual actors (e.g. students, academics, and university administrators) and direct institutional actors (e.g. faculties and departments), as well as indirect actors (e.g. regional and national governments, companies, funders, entrepreneurs). A general effect on these different stakeholders was a broader perspective and range of activities that go beyond institutional boundaries and bring about not only technological innovation, but also organisational and management innovations. In all the innovative practices discussed, 'innovation champions', strong management teams and some external organisations, involved especially in funding, proved to play a key role in bringing about and accelerating qualitative improvements.

At the level of *relationships*, there is clear evidence that when innovative practices are introduced, traditional relationships among actors – individual or institutional – are changed and sometimes even replaced by new ones. At the individual level, all the innovative practices examined intensified the cooperation between the actors, notably academics and students. In the case of Olin College of Engineering, as part of the rationale for an innovative project-based learning approach, students and academics worked together to design the curriculum, an approach which challenges the traditional relationships between student and teacher. The Learning Analytics cases show significant changes in the traditional relationship between student and teacher or mentor, coming from the introduction of technological tools and virtual environments, but also changes in the course design, faculty autonomy and in the roles of the IT staff, who became more sensitive to the way the communication with students takes place. The MOOCs introduced a new role for students in peer assessment. The internationalisation strategy of the University of Nottingham increased mobility and transfer among students and staff particularly at the main Nottingham campus in the UK, attracted high quality academic staff and increased innovativeness in staff working practices. These benefits were shared by the City of Nottingham and the surrounding regional community, strengthening the competitive edge of the city/region economy, as well as the university-city partnership.

At the institutional level, an intensified cooperation and networking among direct and indirect actors, either financially- or non-financially driven, was observed. For example, the US MOOCs and the eAdvisor cases reflect cooperation between higher education institutions and private capital to develop and implement the platforms. BVU is an example of institutional cooperation mandated by the government; the US MOOCs and one of the EU MOOCs (i.e. FutureLearn) have networked institutions or partnerships among institutions as key features; Olin College of Engineering cooperates with institutions specialising in different academic fields to provide a comprehensive education to students and aims at ‘exporting’ its teaching and learning model to other institutions. Increasing cooperation appears thus a mechanism that is adopted to pool existing resources and acquire new ones, share the risk and also some of the costs incurred by the implementation of innovative teaching and learning practices. Increasing cooperation does not contradict the increasing competition that we also noticed among higher education institutions, but the two aspects coexist and manifest themselves as distinct individual and institutional responses at different levels and in different geographic or socio-economic contexts.

Innovative practices changed not only relationships between individuals and between institutions, but also between individuals and institutions. This was visible in some forms of conflict between the new and old forms of teaching, learning, university-faculty relationships, university-external technology providers, intellectual property rights, etc. The rise of ‘star professors’ highlighted by the US MOOCs is a particularly relevant example in this sense, due to its potential to generate significant changes in the configurations of power and privileges in academic hierarchies.

At the level of *system functions*, the innovations examined in this study had the most visible impact on the education function, which was examined from different angles, as this was the main objective of the study. For example, Learning Analytics addresses deficiencies in teaching and in student-teacher interaction, which often result in a lack of engagement with learning. In more advanced systems (e.g. Purdue), Learning Analytics also addresses course structure and quality, encouraging faculty to improve these aspects by providing systematic feedback from students. This makes Learning Analytics an interesting pedagogical tool. The eAdvisor focuses on other aspects of the education function: advising students on their learning trajectories and choices, offering opportunities for course development based on student feedback on various courses; and facilitating student mobility through a number of specific functions. The internationalisation strategy of the University of Nottingham was initially related to the education function of the university, through the campus-based teaching-learning approach called ‘the Nottingham experience’, which was replicated overseas, with considerable efforts in local staff recruitment and learning.

Furthermore, all the innovative practices examined have the potential to spill over to the other higher education system functions, i.e. research and engagement. The impact on these functions could also be scrutinized, due to the innovation system approach adopted in the study. For example, online learning environments proved to serve as a test bed for research on the behaviour of online learners, as shown by the US MOOCs, OpenHPI and Leuphana. Further, the establishment of online learning environments often require cooperation with entities outside the higher education sector strictly speaking, thus contributing to blurring the university boundaries and encouraging the development of ‘third mission’ activities. ‘The Nottingham experience’ initiative also impacted on the research and engagement functions: the new campuses contributed to raising the university’s research profile and to a broader engagement with local stakeholders in Nottingham and in Asia. This contributed to a ‘third mission’ that was strictly linked with the teaching and learning experience, and was reflected in the choice of courses and curricula to be offered. These new partnerships are also manifested in the complex engagement with Nottingham City and the immediate wider region, especially in the Ningbo China development by joint overseas missions, as well as in the local socio-economic environment.

From the analysis of innovation in higher education form an innovation system perspective, three dynamics of particular relevance emerge:

- First, **as innovation diffuses within the higher education system and touches every element of a higher education institution, the transition to an innovative system needs to be better managed.** Many universities have strong business schools that teach these methodologies, but university management is not trained for this: in most cases university managers are promoted academics;
- Secondly, all these aspects underline **a reciprocal nature of change within an innovative higher education system: the system elements (components, relationships and functions) have an impact on the success of the innovation, while success of the innovation induces further changes in the system elements.** A spiral of change is thus created, an 'endless transition' (Etzkowitz and Leydesdorff, 1998) that ensures both renewal and a 'creative destruction' (Schumpeter, 1942) within the higher education system to make it more responsive to changes in the environment;
- Thirdly, **the change induced in a higher education innovation system by the innovative practices examined in the study is not of a radical nature, but rather slow and incremental.** Many innovation practices do not radically modify the traditional higher education institutions' functions; rather, they tend to provide new ways of doing traditional things, all underpinning a constant process of renewal that accommodates practices that respond more efficiently to changing requirements in higher education. For example, the emergence of Learning Analytics and similar initiatives, like the eAdvisor provide new ways of implementing universities' traditional functions (e.g. advising and mentoring students) making use of latest technological developments to achieve old objectives in new, more efficient ways. The concept of macro-level blended learning, e.g. as illustrated by the BVU case study, is an example of implementing a traditional function (course design and delivery) in new ways (e.g. mix of online and face-to-face learning at programme level).

Conclusion:
The development and implementation of innovations in higher education systems have an impact on all the systems elements: components, relationships and functions. At the components level, a wide range of direct and indirect, individual and institutional actors are influenced by these innovations. At the relationships level, the most important effects are due to cooperation, networking and increased mobility, which alter traditional relationships among actors or introduce new ones. At the functions level, the most significant impact is observed on the education function, and a more limited, but growing impact is observed on the research and engagement functions. This may be seen just as a manifestation of the early stage at which many of the innovative practices examined find themselves, rather than an effect of a minor importance of the innovation. Therefore, the impact of some innovation practices on other system functions, such as research and engagement, is likely to intensify and become more visible over time, as the innovation matures and diffuses more broadly into the higher education innovation system. Three dynamics appear to be most significant within an

innovative higher education system:

- As innovation diffuses within the higher education system and touches every element of a higher education institution, the innovation process needs to be better managed;
- There is a reciprocal nature of change within an innovative higher education system: the system elements (components, relationships and functions) have an impact on the success of the innovation, while success of the innovation induces further changes in the system elements;
- The change induced in a higher education innovation system by the innovative practices examined in the study is not of a radical nature, but rather slow and incremental.

6.4. Outcomes and blockages

Four major *outcomes* emerge from the study:

1) **New technologies are important enablers of innovative practices in higher education.** They are often applied to teaching and learning support processes in higher education. Large numbers of students have already experienced new forms of teaching and learning resulting from these innovation initiatives, as the MOOCs, Learning Analytics, and eAdvisor suggest. But these developments do need to be subject to critical analysis. It has been noted already; issues around dropout and student progression in MOOCs and questions relating to quality assurance and accreditation have been raised. It is essential that with developments such as MOOCs, researchers and stakeholders look beyond the headline number count and continue with detailed investigations in order to help better answer the question as to the extent to which MOOCs are offering a rich learning experience for their students.
2) **New technologies support a major shift in higher education that is now increasingly salient around the world, i.e. the transition towards a more student-centred vision of education.** This transition can take different forms: it may include developing new courses and course designs aimed to improve students' learning experience (such as the MOOCs, BVU, and Olin College of Engineering case studies suggest) or it may seek to improve students' feedback and information services and to give them greater choice over their studies (as the Learning Analytics and the eAdvisor case studies suggest). It is recognised that while technologies are supporting this shift, faculty require support, time and resources, so that good learning design and imaginative pedagogical approaches are deployed in order to make an engaging and interactive online environment for students.
3) **Innovation in higher education stimulates the development of partnerships between higher education institutions and other organisations, especially businesses.** As exemplified by the MOOCs, BVU, and Nottingham case studies, the pursuit of innovative practices is often accompanied by the development of new partnerships between higher education institutions and other stakeholders, notably businesses.
4) **Innovations in higher education illustrate well two general key aspects of the innovation process: 'doing new things' and 'doing existing things better',** in various extents that depend on the balance between institutional and national/regional context

factors. Innovations that aim to 'do new things'[22], of which the MOOCs are probably the major example, have the potential to substantially extend the available educational and learning opportunities. They involve new kinds of relationships and provide a greater flexibility in taking the knowledge base of higher education to new parts of society. What society will do with this extended knowledge base cannot be predicted at this stage, but there are potential economic and social impacts from making knowledge more widely and flexibly accessible. There is an emerging model of higher education being primarily a part-time activity over much of the life course rather than a full-time activity for a few years following the compulsory stages of education. On the other hand, examples of innovations 'doing existing things better' included the processing of existing data about students, courses and institutions to inform better decision-making by stakeholders and also by students. In increasingly differentiated higher education systems which provide students with many options of what, where and how to study, innovations which provide better information to inform the many choices which students have to make are clearly desirable.

The *blockages* for innovation can be found both at the institutional level, such as resistance to change and lack of institutional support, and at the national/regional level, such as lack of autonomy of higher education institutions. Gaining institutional support for innovative practices can be sometimes difficult in the case of bottom-up approaches, where a small group of believers has to convince other institutional players to support the innovation. Getting extended support at all levels (from within one's unit to national/regional support) is one of the most persistent bottlenecks for innovation, as it impacts the cooperation within higher education institutions and the cooperation between higher education institutions and other stakeholders. This is explicitly mentioned in the Nottingham, MOOCs and BVU cases. The regulatory framework is also a crucial potential blockage to many innovative practices that needs to be taken into account, for instance those including the use of technology (e.g. the issue of quality and credit recognition in the MOOCs; or the ethical codes to the use of data in Learning Analytics) and those entailing internationalisation strategies (e.g. navigating foreign regulatory regimes).

Conclusion:
Although blockages for innovation in higher education may occur both at the institutional and the national/regional levels, innovative practices do show the potential for delivering high-quality and equitable outcomes, in terms of widening access to higher education, granting students a more central role within the system, and providing potential pathways to cope with the financial pressures that affect the system.

6.5 Policy recommendations

Today, we are living in 'knowledge societies' and higher education institutions not only have a central role in such societies, but their role is also evolving rapidly. In order to adapt to changing circumstances, meet new challenges, and contribute substantially to the societies of which they are an important part, higher education institutions are required to innovate at a pace and on a scale not previously experienced in their long histories. Based on the main dimensions and findings of our study outlined above, we provide in tabular form a set of

[22] Although as recent developments at the US MOOC provider Udacity illustrate, with the introduction of tutors and fee payments, the distinction between "doing new things" and doing "existing things better" may be a flexible one.

recommendations structured along two dimensions: (i) the target audience of the recommendations, namely higher education institutions and policy-makers; and (ii) the theme that the recommendations refer to, namely innovations in teaching and learning, the use of technology to improve student performance and globalisation and multi-campus universities.

Table 7: Policy recommendations and points for consideration by theme and target group

Theme	**Innovation in teaching and learning**
Target group	**Higher education institutions**
	• Nurture an institutional culture to innovation that enhances creativity, creates awareness of the benefits resulting from the implementation of the innovation, stimulates openness to innovation and minimises resistance to change; • Consider incentives and rewards for members of staff (including but not limited to academics) who engage in innovative practices; • Engage faculty members in exploiting the potential of new teaching and learning technologies; • Consider the use of cross-institutional collaboration to improve student choice and quality (and possibly cut costs); • Put in place adequate measures for skills development of teaching staff and also for greater collaboration in performing their teaching duties; • Review existing organisational boundaries and linkages.
Target group	**Policy-makers**
	• Establish a clear regulatory framework that addresses blockages that online learning is faced with today, including: quality assurance mechanisms, credit recognition processes and IPR regulations.
Theme	**Improving student performance through technology**
Target group	**Higher education institutions**
	• Identify the (diverse) needs and circumstances of the learners; • Ensure learner access to relevant technologies and possession of necessary skills to gain maximum benefits from them; • Recognise that the successful introduction of learning analytics will be dependent not only on the choice of technology but on making the institutional changes necessary so that teachers, IT staff and administrators work effectively together to support students; • Provide appropriate processes, tools and support activities so that faculty are able to fully utilise the rich data generated through analytics to enable them to respond to individual student needs and to further develop their teaching; • Clarify the roles of the different actors (within and beyond the institution) involved in meeting these needs;

	• Ensure a collective understanding of the different roles/responsibilities and the relationships between them; • Ensure clear lines of management responsibility and information requirements to assess performance; • Build supportive relationships and trust between the relevant actors (students, academic staff, support staff, IT staff, managers and, where applicable, employers).
Target group	**Policy-makers**
	• Clarify the funding implications, intended outcomes and timescales for the innovation; • Collect and analyse feedback information (from learners, institutions, employers etc) on performance and impact, and inform all relevant actors; • Identify any unintended consequences of the innovation (e.g. for other functions, for widening participation or labour market linkages).
Theme	**Globalisation and multi-campus universities**
Target group	**Higher education institutions**
	• Balance commercial, educational and reputational considerations in formulating overall international strategy; • Address a range of interconnected factors such as student mobility (inward and outward), student placements, qualification recognition, funding implications, curriculum and pedagogic implications, and labour market linkages; • Consider the needs of different actors including home and international students, academic and support staff, quality assurance agencies, employers and sponsoring bodies; • Engage 'home' staff and to build relationships between staff located at the different campuses; • Establish how much to 'export' from the home institution and how much to build to reflect local contextual factors at different campuses; • Establish how much to 'import' from the international activities to reshape the home institution; • How to satisfy different national regulatory and quality assurance regimes.
Target group	**Policy-makers**
	• Providing support for inward and outward mobility of students.

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Contents

1. Case studies monographs

The internationalisation strategy of the University of Nottingham (UK) and the establishment of campuses in Asia

Authors: Professor Michael Osborne, Professor Chris Duke, Dr Fumi Kitigawa and Dr Ming Cheng

Overview

a. **Drivers:** The University of Nottingham's overseas expansion has been driven by challenges of globalisation; the challenge being met is one of modernisation of the University and ensuring world-class standing through internationalisation as a deliberate strategy for a university located outside the 'golden triangle' of England's South East. The innovation covers a long period and is an institution-wide 'entrepreneurial' transformation. The idea flowed from a period of disruptive change under a forceful new and young Vice-Chancellor demonstrating firm will and building a record of achievement.

b. **Strategy**: The Malaysia Semenyih and China Ningbo Nottingham campuses are the most evident examples of a wider internationalisation strategy. They are distinctive by virtue of echoing the Nottingham Park main campus architecturally and in replicating the 'Nottingham student experience'. A key to sustained success and continuing innovation has been the stability of top management; the recent new vice-chancellor had been at Nottingham even before Sir Colin Campbell. Key staff moves between such roles as PVC International, Dean, and Provost of the Ningbo and Semenyih campuses. The University has appointed a Chinese Chancellor (the titular Head of the whole university), highly symbolic and a rarity for European/UK institutions.

c. **Outcome**: The University of Nottingham Malaysia Campus (UNMC) with about 4,500 students and the University of Nottingham Ningbo Campus (UNNC) with 5,500 students have been created and these campuses are also developing research capacity.

d. **Key factors for success**: effective leadership, long and stable management, adoption of established quality standards, funding assurance, prestige of the well-regarded UK university system, local business investments.

e. **Implementation challenges**: There have been major external and external challenges to overcome. The developments required very high and prominent levels and forms of national support in each of the countries involved, and had to build strong links with the local economy ensuring success based in relevant engagement. The innovative internationalisation initiatives have developed as part of the higher education system in the UK, with the courses and teaching at the overseas campuses subject to the same quality assurance processes as in Nottingham. Internally it has been about the challenge of bringing all key players on board.

f. **Main changes**: Creating the Nottingham campus experience at other locations. Full integration of the three campuses; and the appointment of a Chinese Chancellor, highly symbolic and a rarity for European/UK institutions.

g. **Results:** Nottingham has established itself as a global university with high quality standards and maintains an ongoing pace in improving its services.

Part A: Setting the scene: introduction, challenges and contexts

A1: Introduction: definition of the innovation initiative

Overall objectives of the initiative and future plans

In this case study, innovation concerns the institutional strategies and the leadership related to the internationalisation of the University. The key objective of the initiative studied is to secure and enhance the University's position and reputation as a national and international institution.

The initiative started with plans to set up two international campuses in Malaysia and China, originating in the 1990s. This innovation needs to be seen as part of deeper and wider institutional processes: the initiatives aimed not only to make Nottingham a global university, but to transform its identity, mission and ways of working from deeply conservative to vibrant, visionary and imaginative.

The initiative is seen as "deliberatively disruptive". The overall objective of establishing the two Asian campuses, in Semenyih, Malaysia in 2000, and Ningbo, China in 2004, was to create a different identity and stature for the University than could be won in the UK alone; to progressively embed an attitude of innovation and an international outlook throughout the University; and thus to create a habit of continuous development – permanent non-violent revolution. Summer schools introduced on both Asian campuses in 2011 are one of many examples, as is the plan to make them credit-bearing from 2014. A new (2013) senior management structure sees the pro vice-chancellor (PVC) International joined by four part-time Assistant PVCs International with a brief to work in four regions: the Americas, Asia, Europe and the Middle East & Africa.

The University intends to continue along this path of innovation as a leading international university with a high reputation and high standards. There are no plans to replicate the campus model in other countries, which is very demanding of management time; but Nottingham is open to future possibilities consonant with sustaining the highest standards.[1] It

[1] Nottingham was 'one of the first to embrace a truly international approach to higher education', according to the *Sunday Times University Guide 2013*. It is ranked in the UK's Top 10 and the World's Top 75 universities by the Shanghai Jiao Tong and the QS World Rankings. (University website, accessed 1 July 2013)[1]

replicates “the Nottingham student experience” in Ningbo China and Semenyih Malaysia, tightly managing reputational risk.

Outcomes of the practice

Expansion and transformation started at home with expanding student numbers, a renewed curriculum, and the new Jubilee campus in 1999. In 2000, the University was awarded a Queen’s Award for Enterprise in recognition of its work in recruiting overseas students and its decision to open a campus in Malaysia.

The plan to establish a campus was announced in 1998 after an initiative in Thailand fell through. The original Kuala Lumpur campus started in 2000 under the auspices of a Joint Venture company established by the University with two partners, Bousted and Yeoh Tiong Lay (YTL) Corporation, and courses in three fields of study. Plans were modest but student numbers were still lower than planned. Over time, YTL’s interest in the venture diminished and the role of Boustead (influenced by considerations of national interest and corporate social responsibility) increased. The University persisted and adapted in the face of recruitment difficulties and changed partnership arrangements. YTL effectively became a “sleeping partner” with a smaller proportionate holding, while Bousted became increasingly active. Practices were modified with experience, initially more vocationally-oriented courses and disciplines were added, and relations for accreditation with professional bodies established. Subsequently a broader range of less vocationally-oriented programmes was introduced. With success, new capital was raised for future investment. A substantial share of the financial risk was borne by the majority shareholder in the joint venture, but the University has been willing to invest its share of any capital calls. The Semenyih campus opened in September 2005, then the KL Chulan Tower city campus in early 2006. Research students were recruited at an early stage in the campus’s development. Research funds and programmes followed. UNMC now has about 4,500 students. It plans to increase to about 6,000 by 2020.

The University of Nottingham Ningbo Campus (UNNC) started later. UNNC, which opened in 2004, is the first Sino-foreign collaborative university under the State Council decree No. 372 on 1 March 2003.[1] In 2010, it became the first foreign university in China to be designated an “international cooperation base" - a status awarded to universities and companies with successful international research collaborations. In 2010, Chris Rudd, then the pro vice-chancellor who leads Nottingham's strategic partnerships group, said the award ‘signals our arrival as a mature and respected provider of research and knowledge transfer, delivering UK excellence with an Asian flavour’ (THE, 4 November 2010). The campus, on a larger footprint, architecturally echoing features of the original University Park campus in Nottingham, now has some 5,500 students rising by 2020 to 8,000. As with UNMC growth has been steady, significantly widening the curriculum offerings, involving more Schools, and connecting strongly with the economic and other needs of the Ningbo City and wider region. As in Malaysia, the campus has attracted vital national interest and support. It too enjoys high academic status and has also maintained a very strong financial position. A striking recent change at Ningbo has been widening demand for fields of study and degree courses not obviously vocational, in the arts and humanities. This befits an elite and prestigious English-style liberal arts tradition as a route for high career ambition.

Table 1: Total student numbers in 2011/2012

	Nr. of students in 2011/2012[2]	Nr. faculty staff
University of Nottingham Malaysia Campus (UNMC)	3,869	450
University of Nottingham Ningbo Campus (UNNC)	4,832	513
University of Nottingham UK	34,076	7,000

The UK Quality Assurance Agency (QAA) for HE has always taken a close and critical interest in overseas partnerships, franchising and other forms of collaboration. The QAA Review of the UNNC in November 2012 commended the fact that UNNC had achieved its stated intention to provide the 'Nottingham experience' in China in less than eight years. The review also noted UNNC’s fruitful relationships with Chinese institutions and Ningbo city itself that has benefitted from the import of expert foreign resource, and the long-term relationships that have been formed between the University and the local community (QAA, 2012). Its unqualified endorsement of the work at Ningbo was later celebrated at Nottingham.

In November 2012, the University launched a new joint venture in collaboration with the East China University of Science and Technology: the Shanghai Nottingham Advanced Academy (SNAA). The SNAA will deliver joint courses in Shanghai including periods of study in Nottingham UK, with teaching and research at undergraduate, postgraduate and doctoral levels.

University of Nottingham was chosen as the Guardian University Awards 2013 “International Strategy” winner. As of February 2013,

> *“Over 9,500 students are enrolled in Malaysia and China, and as well as having one of the largest cohorts of international students in the UK, Nottingham is a top 10 recruiter (by volume) in most markets worldwide.*
>
> *As the first university to open a fully operational branch campus in Malaysia in 2000, internationalisation has been in the University of Nottingham DNA for well over a decade.*

[2] http://www.nottingham.ac.uk/about/facts/studentpopulation20112012.aspx

> *It has since opened a further campus in China, and says that global reach is "hardwired" into its strategic plan". (The Guardian, 28 February 2013).*

Both campuses have had very high-level visitors including the Heads of State of all three countries. The Nottingham campuses in China and Malaysia stand out among other elite high-fee private universities. They share Nottingham's strong research profile as well as encouraging and rewarding active learning required for leadership and sought in both countries. The overseas campuses have proved welcome and beneficial in Nottingham City, where both Vice-Chancellors (the other university being Nottingham Trent) have engaged strenuously with the City community and the local region.

Funding of the initiative

Both overseas campuses benefit from local business investment as well as municipal government funding in China. This has underpinned growth; surpluses have been used to reinvest in each campus. In both cases, where the UK campus incurs costs relating to the QA processes, these are recharged to UNMC and UNNC. Several senior staff stressed the importance of maintaining strong financial positioning of UNNC and UNMC within the overarching system and the University of Nottingham, something closely scrutinised by the University Council as the Governing Body in Nottingham, with interest taken also by the Higher Education Funding Council for England (HEFCE) from the outset and Nottingham being a very visible player. In an integrative academic model the overseas campuses are part of the Faculties and Schools at Nottingham. As Schools' participation has widened, the costs and benefits have become more dispersed and embedded in the regular running of the University. The time and cost of senior management conceiving, creating, developing, overseeing and hands-on managing the two overseas campuses is significant; its mainstreaming illustrates commitment to innovation as "permanent revolution". Being global has increasingly become the norm as staff members are made aware of the major opportunities for their career progression by engaging actively with the international campuses. This continuing institutional innovation is in stark contrast to some other separately and externally funded, project-based short-term initiatives, where little remains after the project is finalised.

The initial and ongoing funding illuminates the thinking which has led to its success. The student-fee base of the overseas campuses as fully private ventures prefigured the current emerging shape of the funding of teaching in England. An important additional dimension is that in both Asian countries, UNNC and UNMC have access to government-funded, competitive research grants, although there is no core research funding available to private institutions in Malaysia.

Funding assists, but does not drive, development. The high cost of managing the present systems is well recognised. Thorough hands-on top management requires the Vice-Chancellor to make six or seven annual visits to Asia. There is much travel in both directions by staff as well as students. The Chief Financial Officer recognises the complexity of the current management systems across all campuses, with some 200 different business systems in the UK alone. Re-engineering the financial and student management system to bring records together will facilitate student and staff movements and other records, and make savings. This requires time now taken up with ongoing management of present systems. A fully joined-up backbone will be expensive and might take three-four years to set up.

A2: Understanding of the context

The institutional, geopolitical and regulatory context

Institutional context

The University of Nottingham is a member of the Russell Group, a loosely defined association of the leading research-led universities in the UK. The University was founded in 1871 as University College, Nottingham, offering teaching for University of London degrees and providing opportunities mainly for local students. Nottingham received full university status in 1948, and since the 1950s it has seen its primary role as being national and, particularly during the past two decades, international. Like all UK universities it is a self-governing institution with full control over its academic and financial affairs[3].

National context

The national context was one of increasingly sharp competition between institutions and institutional groups. Nottingham belonged to the most elite of the several groups in an HE sector enlarged by the 1992 conversion of polytechnics to 'new' universities seen as having a stronger regional mission. The elite Russell Group, described as research-led, derives status from research output, the most powerful criterion in national and world rankings, and from high academic student intake. Leadership style became more directive, described as managerial rather than collegial. As institutions grew in size many were restructured to enhance efficiency with devolution; in some cases to very large units grouping faculties and schools within a few colleges. Undergraduate fee levels almost tripled under the Labour Government in 2003, and tripled again under the subsequent Coalition in 2011. One consequence has been more complaints from students as consumers dissatisfied with the teaching they get for their money, fuelled by government interest for example in contact hours, an example of increasing intrusion into what was formerly seen as private university business. The (current) national research assessment exercise (REF) introduced 'impact' as a

[3] In the UK, its legal status is that of a charity, which is required to use any financial surplus it generates for the furtherance of its academic and educational work as set out in its Royal Charter, and in return receives certain tax concessions. Apart from this it is able to undertake any activities it considers worthwhile, subject only to the contractual conditions set by the government and other sources of finance. Like most other UK universities it has, since 1988 with encouragement from the national government, used its autonomy to behave, in effect, as a medium-sized commercial enterprise, whose core business is selling academic services.

new significant criterion (see Smith et al., 2011), but the research function judged by traditional output and quality criteria dominates the competitive reputational environment. This marginalises the '3rd mission' of regional engagement for many. This and a highly qualified student intake, strong income streams and good financial reserves characterise the policy environment and priorities for most Russell Group institutions.

Geopolitical context

The University of Nottingham is the senior of two universities in the large regional industrial city of Nottingham, its popular history and identity deriving from Nottingham Forest and the legends of Robin Hood. This is former coal-mining country in the English East Midlands, just on the southern side of the economic and cultural North-South divide that splits England and the UK. Nottingham has a more diverse and somewhat less stressed economy than many northern towns. It nevertheless faces the multiple socio-economic problems of the UK. The City Council is seeking ways to restore economic growth following the demise of the Regional Development Authorities (RDAs) under the current UK Coalition Government.

There is therefore keen interest in what the universities can do to support innovation across their teaching, research and engagement missions; and, among the more forward-looking, keen interest in the potential of 'soft landing sites' in the booming South-East Asian and Chinese region and economies. Like the University, the city council is said to include both innovators and more conservative members slower to embrace new ideas.

The UK HE institutional map largely mirrors the economic geography map of the UK. The nation is increasingly 'tilted towards the South-East'. Wealth, power and human resources drain to the Greater London area. Known as the higher education Golden Triangle of Oxford, Cambridge and London (Imperial, UCL and other powerful London institutions), this dominates global rankings, research income, wealth, reputation and prestige.

The context of the internationalisation encompassing the three countries directly involved has changed rapidly and significantly over the period of the innovation: it is 20 years since an Asian campus was first considered, 15 since the first announcement about the Malaysian campus, and over ten since Ningbo work began.

Malaysia developed a strategic ambition to become an education and higher education hub of South-East Asia. UNMC started as an incorporated partnership of Boustead Holdings Berhad, YTL Corporation Berhad, and University of Nottingham UK. It is attractively located at Semenyih, 30 km outside the Malaysia capital Kuala Lumpur. There is also a KL downtown city presence. UNMC's active main partner is still the conglomerate Bousted Holdings Berhad. Boustead and YTL are mostly held by Malaysian investors and focus on a wide range of interests including plantations, property, services including education, and infrastructure building. These arrangements can restrict institutional autonomy, but also serve to "protect the home campus from some financial risks, particularly if the endeavour proves unsuccessful" (Lane, 2012). YTL quickly became more of a sleeping partner, its stake falling to 5%. Bousted has wide economic interests connected in many ways to the booming Malaysian economy. It is keen to exploit the knowledge economy potential of elite UK higher education in its own and the national interest.

Similarly the Ningbo development is in a fast-growing city on the South-East China coast, soon to be connected by high-speed rail bringing it within two hours of Shanghai. Its population is thought to be some seven million registered, with an additional approximately three million migrants. It is the second largest port in China, and fourth or sixth in the world depending on the criteria used, in a fast-growing and prosperous part of China. The geographical economic and now political environment is thus highly favourable in both Asian countries. This advantage is reflected in the influential and high-level supporters and ongoing health of innovation on both countries.

Regulatory context

British universities are autonomous institutions, although there are a number of mechanisms for public accountability and assurance. The policy environment of UK higher education, especially in England following partial devolution to the different countries in the UK, has been increasingly demanding and at times difficult.

The key funding and regulatory body in England is HEFCE. HEFCE is a funding body for universities and colleges in England, which allocates public funding for HEIs, and monitors and addresses financial and other risks associated with HEIs and related bodies. Their priority focus is on activities within England. HEFCE is generally concerned with the financial health and performance of the institutions.

The government body responsible for higher education policy and its regulatory arena has changed several times over the past decades and is currently the Department for Business, Industry and Skills (BIS). These and other changes in government policy are characterised as turbulent 'churn'. The climate has changed from one of broad encouragement of growth ('Education, education, education' and a 50% age participation rate for HE were the mantras of the Blair government of 1997) in the late nineties to one of damaging criticism of the sector and severe fiscal constraint. This has driven universities to diversify income streams, massively raise fees (notably in England), privatise some operations and become more entrepreneurial. This includes becoming more relevant to the economy in teaching, research and economic/societal engagement, and more transparent, making for a tough working environment. On the other hand, creating and generating income from new private university branches in key markets abroad naturally accords with government policy inclination.

The main agency concerned with teaching quality is the QAA, established in 1997. The QAA safeguards the public interest in the quality and standards of UK higher education. The QAA takes a leading role in international developments in standards and quality. Arrangements such as franchising come under close scrutiny, especially with overseas partners. This meant that the early and innovative Nottingham arrangements in Malaysia and China would be of particular interest.

The regulatory environment in Malaysia and China was in an obvious sense more challenging, yet appears to have been easier to navigate in reality. Any post-colonial legacy and worries about the motives and standards of overseas investors seeking entry are balanced by the desire for expansion and high quality in universities to underpin economic development. Managing start-up in Malaysia required tact and care; some overseas universities over the years, including some from the UK and Australia, quickly withdrew. In China it was not possible until early last decade to create such an arrangement at all, so Nottingham needed to pioneer a new model and legal identity in a country still quite new to such partnership in any sphere, and to navigate issues of relevance and utility as well as financial viability and standards.

High standing, and the prestige of the well-regarded UK system of oversight and quality assurance including that of the funding council and QAA, made the regulatory environment navigable with care. The dual administration in which the Communist Party remains a key power proved manageable and indeed supportive. The UK QAA system was trusted to assure quality, leaving the task of negotiating professional recognition and the right to practise to the institution.

A3: Challenges and drivers

The challenges that the initiative aims to address

The initiative aims to address the challenge derived from the higher education policy environment, and the increasing difficulty of leading and managing a large university with a strong sense of identity, purpose and direction, as well as prosperously in more difficult and competitive times. Nottingham grew rapidly at this time, with a desire to be distinctive and highly regarded. With a forceful new Vice-Chancellor it underwent major transformation as well as expansion. Ambition meant thinking globally rather than predominately nationally. The challenge was to make Nottingham a leading innovation global player by internationalising. The two Asian campuses were the most prominent and leading part of this strategy. The whole UK HE sector was also expanding. Many institutions looked abroad for new business opportunities. The University aimed to be a sector leader, accurately reading emerging contextual necessities and moving effectively to prosper in hard times. Going global opened up opportunities for competitive advantage and a new sense of identity and purpose less easily available in the constraining UK context. Learning how to create, negotiate and sustain new modes for new overseas campuses was a main challenge. This continues well into a second decade. It means sustaining a culture of innovation, being open to community and client needs and feedback, and building on these successes without cutting off opportunities to innovate globally in new and diverse ways.

The immediate cause for developing the initiative

There was no single critical and immediate trigger for this initiative. It was driven by a determination to be outstanding, to avoid being overwhelmed by intense competition in a more entrepreneurial environment, and to eradicate complacency. It grew out of recognition that a northern East Midlands university could not relocate into the Golden Triangle and the charmed circle where the highest prestige was assured. It was already a Russell Group member, and a founding member of the international Universitas21 group of research intensive universities (U21) started in 1998, thus staking an elite presence globally as well as nationally. **Adopting a global rather than mainly national identity to secure the institution's future** became part of the strategy of the new and long-serving Vice-Chancellor. UNMC and UNNC provided a visible and challenging manifestation of this new aspiration. The risk was considerable, but dominantly reputational, rather than directly financial. The highly ambitious innovation resulted almost entirely from the vision, drive and opportunism of an unusually young and energetic leader, with the blessing of a University Council which as the governing body saw the need to reinvigorate what some saw as conservative complacency, and the capacity to create a strong and loyal team of active senior managers. The result and it seems the intent was a cultural revolution: a continuing ever more deeply embedded process of becoming vibrant, innovative and risk-taking, with continuous innovation as a way of life rather than a time-bound incident.

Part B: The higher education innovation system: functions, components and relationships

B1: Analysis of the functions

The function to which the innovation is related

The 'innovation system' affected the delivery of teaching at the two overseas campuses and implied the transformation of the University of Nottingham from a static and conventional to a dynamic model. It meant retaining a campus-based teaching-learning approach called 'the Nottingham experience', and replicating it within the same unitary faculty-school-department-curricula model much as local Nottingham campuses were added to the original University Park campus.

The same academic and management structures and processes were used, with significant time and cost invested in developing local capital and human resources, seconding key staff for significant terms, and exercising the same teaching development and quality assurance systems as at home.

It also required more of the kind of adaptive innovation seen at home to make courses and curricula more relevant to the needs of the environment and the economy. Where problems were discerned specific to the context and culture, different behaviours were required; for example, both countries saw the need for more active learning to produce innovative leaders for a knowledge-based economy. Teaching was adapted to encourage and reward active class participation. Whereas initial degree programmes in both countries were essentially vocational, linked to obvious career openings like branches of engineering relevant to the region and to key partners, a (surprising) demand emerged for more general liberal arts and humanities programmes at Ningbo, so curricula and course options were widened accordingly.

Impact of the innovation on other functions

In the sense of using internationalisation as part of sustained strategic institution-wide transformation, the innovation embraced all the core functions of a university. For convenience we treat research and the 'third mission' of community, regional service and engagement separately, not as subject to the 'impact' of new campuses and the teaching that was provided. The initial innovation as thus manifested overseas was in teaching (and progressively towards more active learning).

Part of the identity and appeal was that Nottingham was a research-led university. Teaching can start up quicker than research when connected to and supported by local needs and resources. Within a few years however research connections were made and priorities identified and supported. Although teaching provides the main source of operating income, research is seen as an integral component of the activity of UNNC and research funding is being received from a diversity of Chinese public and private sources (Ennew and Fujia, 2009).

Now Ningbo makes a significant contribution to Nottingham's research identity and profile by virtue of its Marine Economy research and R&D. Similarly UNMC is becoming eminent for its collaborative *Food for the Future* research programme. Quite distinct and a different 'model of innovation' is the development of another research initiative in a different part of China, the new advanced research academy in Shanghai. It could be argued that this innovation was partly inspired by the success of Ningbo in that vitally important country; but in reality it was part of a wider internationalisation agenda, and in this sense a 'free-standing indirect beneficiary'. Clearly the 'third mission' of regional and community engagement and service permeated the innovation from the outset. In this way it was and is interwoven and inseparable, a characteristic and dimension of the developing teaching activity rather than a distinct 'function'.

B2: Analysis of the components

Identification and description of actors involved

The innovation processes have been taking place over several years, led by entrepreneurial institutional transformation. The original initiatives were taken by the visionary institutional leader, Sir Colin Campbell, the Vice Chancellor at the time.

The innovation was distinctive in being a process of continuous development and change in the light of feedback and experience. This process continues with additional PVC leadership strength and clear plans for expansion of research as well as teaching within a proven model. Strong unbending leadership is shared by the top and senior management team with ideas from different members and rolled out. Gradually enthusiastic existing and new staff have balanced top-down drive with energy, commitment and initiative from below. A key to sustained success and continuing innovation has been the stability of top management; the recently appointed vice-chancellor had been at Nottingham even before Sir Colin Campbell.

The institutional change has been supported by external stakeholders such as the city of Nottingham and the local governments in China and Malaysia where the international campuses were being developed. As Shattock (2007) points out: 'there is no doubt that an overseas campus is an extremely high-risk experiment'. Alongside general business risks there are also more specific risks associated with the development and maintenance of a partnership relationship and the need to deal with cultural and linguistic differences. Staffing and management stretch have also been identified as key concerns (Matross Helms, 2008). The University, by collaborating with key external stakeholders, has managed these risks and built reputations.

Table 2: Actors/stakeholders, level of operation, roles and responsibilities and activities

Actor/stakeholder components	Level (macro, meso, micro)	Role/responsibility	Activity
Institutional actors: ▪ Vice Chancellor, and senior management team ▪ University of Nottingham	Micro and meso	▪ Envisioning international strategy; ▪ Mobilising resources; ▪ Institutional leaders/entrepreneurs	▪ Opportunity spotting, planning of international campuses; ▪ Identification of partner institutions; Negotiations, ▪ Execution of international campuses
External stakeholders: ▪ City-regions (e.g. Nottingham, Ningbo,	Meso	▪ Partnership building; ▪ National legal and financial frameworks;	▪ Physical planning and development of the campuses;

Semenyih) ▪ National government (e.g. China and Malaysia) ▪ Foreign partners		▪ Risk sharing/management	▪ Local job creation; ▪ Financial investment; ▪ Providing services ▪ Student recruitment
National regulatory bodies (e.g. QAA)		▪ Quality assurance; Risk management	▪ Auditing of teaching quality of international campuses; ▪ Sharing of good practices
International markets: ▪ Students ▪ Academics	Macro	Economic opportunities; Solving global challenges	Internationalisation of teaching and learning; Internationalisation of research and impact

B3: Analysis of the relationships

The nature of the relationship

Managing the three international campuses with varying degree of resources, history and reputation with different sets of activities and student numbers requires the careful building of a number of relationships across campuses within and beyond the institution. This is reflected in the way the highest authority within the university is organised. There is one Chancellor for the whole University (including the three campuses). Periodic meetings are held in each of the three sites with the governing body travelling to them in turn. The two campuses in Malaysia and China have a Provost, who is the Executive Head also holding PVC status at the University of Nottingham. These therefore, have a dual identity. In addition, they are part of the unitary top management team (the Provosts quite often are in Nottingham). Each campus is governed taking into account the local customs.

The balance between teaching and research activities conditions some of the relationships between actors. Although teaching provides the main source of operating income for the overseas campuses, research is seen as an integral component of the activity of both the China and the Malaysia campuses. Already there are six functioning research centres at the University of Nottingham Ningbo, China.[4]

Changes in existing relationships

[4] These include the Institute for Comparative Cultural Studies, the Centre for Sustainable Energy Technology, the Centre for Global Finance and the Centre for Research in Applied Linguisitcs. Research funding is being received from diverse Chinese public and private sources. In November 2008, the Leverhulme Centre for Globalisation and Economic Policy, which was initially established at the University's UK campus, opened a branch at the Ningbo Campus. A regular programme of international conferences and seminars provides an opportunity to bring together leading scholars from China and around the globe to address key challenges within and across disciplines (Ennew and Fujia, 2009). The Malaysian campus has major research initiatives such as the Crops for the Future research centre, which was given funding approaching $40m from the Malaysian government.

In 2001, the University appointed Professor Yang Fujia, former President of Fudan University, as its Chancellor. In developing its engagement with China, the University had a number of overarching objectives, which were articulated by the Chancellor and Vice-Chancellor as follows and which guided the new campus initiative (Ennew and Fujia, 2009):

1. To bring together the best of UK and Chinese educational values and practices;
2. To educate generations of students as truly international citizens, rooted in their own cultures but aware of, and sympathetic towards, other cultures;
3. To encourage international research, not by 'staying home' but by working in a host country and concentrating upon subjects that are mutually beneficial to Nottingham researchers and Chinese society.

Impact of the relationships on the innovative practice

One of the ways the University ensures impact of the relationships on the innovative practice is through "people mobility and transfer" at the highest level of personnel within the organisational architecture.

While leadership from the home campus at the highest levels was essential, the management of core academic processes has followed an embedded model in which the University has sought to devolve and distribute responsibility to key units at the home campus. Accordingly, academic units at the international campuses are regarded as part of their home school. Thus, the University's Business School, School of Computer Science and Faculty of Engineering may be viewed as single academic units with bases across all three campuses.

Furthermore, key senior university staff moves between such roles as PVC International, Dean, and Provost across the three campuses in the UK, China and Malaysia, ensuring sharing values across the three campuses. For example, Professor Christine Ennew, currently Provost of the Nottingham Malaysia campus, was previously a Pro-Vice Chancellor International at Nottingham campus.

Mobility of people is not only at senior academic level. A new £17 million International Doctoral Innovation Centre at the University's China campus will train 100 of the brightest PhD students – who will split their time between the UK and China – in the fields of energy and digital technologies (*The Guardian*, 28 February 2013). In the longer term, the geographical and cultural spread of the university's student body is creating a "global alumni network" that is extensive and growing fast.

Table 3: Relationships between actors

Actor 1	Actor 2	Relationship	What changed?
Chinese	Vice Chancellor	Highest level of	Strategic objectives being

Chancellor appointed		people-based strategic alignment	implemented in engaging with China
PVC International, Nottingham	Provost, Malaysia	Mobility and transfer between senior leader roles	Sharing institutional culture, practices and value across the campuses

B4: Cross-elements analysis

Mapping the system and stakeholders

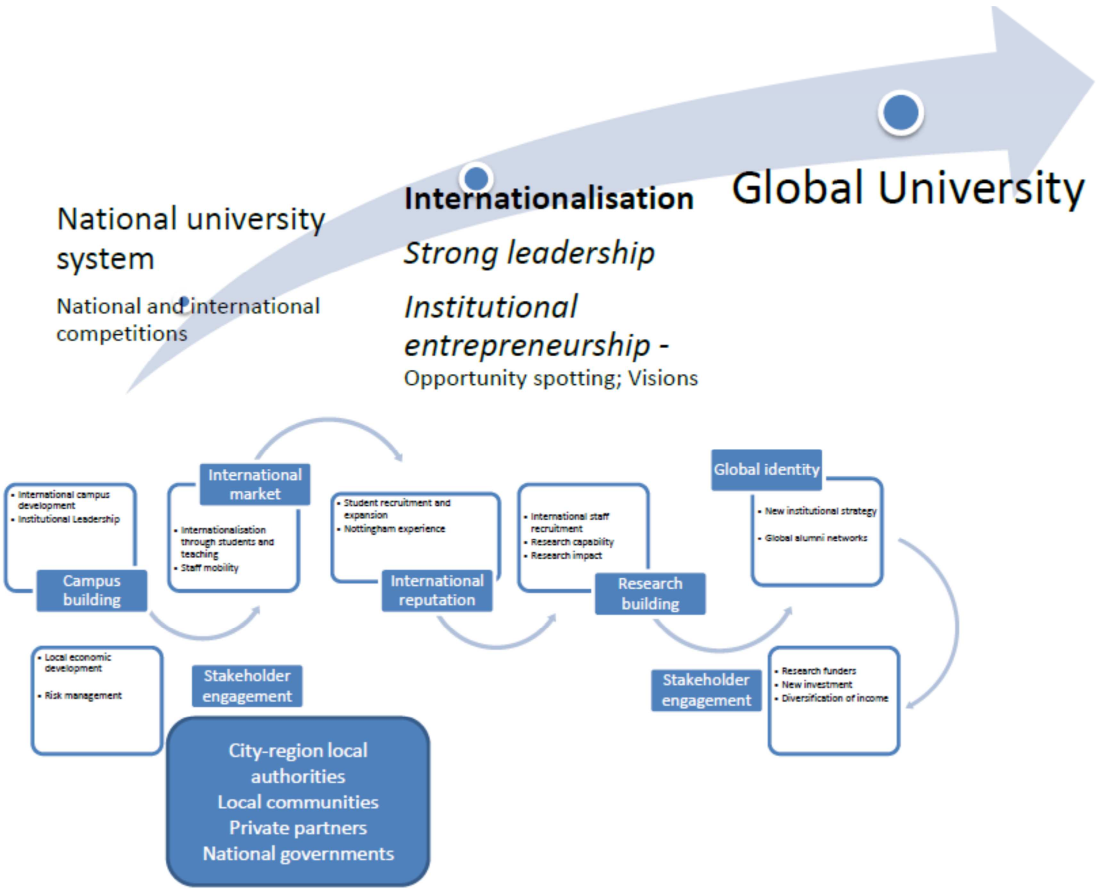
For the university, the higher education innovation system is two-fold. Firstly, there are external stakeholders that the university interacts with, including local authorities, national governments, private sector partners and funders. They constitute the components of the higher education innovation system as distinctive 'actors'. Secondly, the key 'linkages' of the system are maintained through the University's main activities, namely, teaching, research and engagement with economy/society. The University's main sources of income are through teaching students. Building research excellence is the key part of its institutional profile, and engagement with the stakeholders is the key to sustain the external linkages.

What are the major stakeholders and how do they interact?

Through its internationalisation strategy, the University of Nottingham created a new identity encompassing three geographical locations, where the University's different activities - namely, teaching, engagement and research - interact. The strong institutional leadership that originally spotted opportunities and since then has provided visions and resources, combined with strategic alignment with external stakeholders at multiple levels in multiple locations – the city of Nottingham, the cities of Semenyih in Malaysia and Ningbo in China – with strong support from the respective national governments and private partners. The multiple levels of partnership have enabled the innovative global enterprise to take off and continue thus far. This journey has been supported by national and international regulatory mechanisms, assuring quality as well an existing and growing reputation as a truly global university.

The innovation processes through internationalisation can be presented schematically as follows:

Figure 1: The internationalisation process



Conclusions related to the innovation system map

Given the complexity of the inter-relationships and dependencies between stakeholders in multiple national settings, inter-linked university activities and management of resources across teaching, research and engagement, the concept of an *innovation system* provides the best framework for ensuring a comprehensive understanding of the innovation processes throughout the internationalisation. The innovation system model adopted should be capable of considering the breadth of issues and challenges encompassing various phases of internationalisation.

- Through internationalisation, the building of the two overseas campuses and the delivery of teaching at the overseas campuses has transformed the position of the University of Nottingham within the national system of higher education.
- Through its internationalisation strategy, the University of Nottingham created a new dynamic model of innovation - encompassing three geographical locations, where the University's different activities - namely, teaching, engagement and research interacts, embracing all the core functions of a university.

- The strong institutional leadership originally spotted opportunities and since then has provided vision and resources.
- High-level staff mobility and transfer has been the key instrument to new relationship building, along with the development of research capability across the three campuses and building the international reputation under "Nottingham experiences", creating the new identity as a global university.
- Strategic alignment with external stakeholders at multiple levels in multiple locations has been critical for the process – the city of Nottingham, the cities of Malaysia Semenyih and China Ningbo with strong support from the respective national governments and private partners.

Part C: Outcomes, assessment and conclusions

C1: Conclusions: outcomes in terms of expected and unexpected consequences

Barriers and bottlenecks

On the one hand internationalisation at Nottingham and its two overseas campuses was purposeful, well thought and talked through during the nineties. Different models were considered, compared and dropped before the full-scale extension and replication of Nottingham overseas was adopted. Obvious barriers of internal conservative resistance (or sheer incomprehension) were largely circumvented. So was 'parochial' resistance and suspicion of motives in Malaysia and China, where high-level patronage was used successfully. On the other hand staying power and sustained openness to new experiences, feedback and new ideas, along with pragmatic flexibility, allowed difficulties to be overcome, like the disappointingly low initial enrolment in Malaysia and the conflicting ambitions of the two local business partners. Relations with all three governments were carefully handled, with sensitivity to local norms and practices, British as well as Malaysian and Chinese. The Vice-Chancellor had a genuine interest in the history, culture and ways of the partner countries and became well versed in these before and while doing business. The only evident bottleneck was in the scale and cost of very senior management time needed for the thorough hands-on approach adopted. This was resolved by staying with just two campuses, and using other means for internationalising in other places and ways. The staffing and management of an international campus has presented particular challenges. IT limitations became evident with much enlarged scale and are being addressed in coming years.

The former Vice-Chancellor spoke of a severe but temporary crisis around the end of last century. A politically motivated attack through the media singled out the University as supposedly going in unprepared for a quick, unscrupulous and ill-thought-through killing. Whether this was an accident of resentment of Russell Group elitism falling on Nottingham, or a consequence of a strong Vice-Chancellor making unpopular changes, is for speculation. The successful defence was to track the consideration of the idea as it firmed up over several years, enumerating discussions in Senate and in the key strategy and finance committees of Council. An external probably ideological attack was thus defeated much as internal resistance to change was overcome, by patient preparation.

The challenges for the University of Nottingham in China that were expressed by an officer of the Higher Education Evaluation Centre (HEEC), are instructive and for him are similar to those for Chinese universities themselves. These include how to realise internationalisation of a university, instead of simply becoming a branch of a foreign university or just focusing on some international exchange activities. Rather from his perspective the task is to cultivate talented students who have international views and experience, who understand different cultures and become capable in actively engaging with international affairs, and know about international regulations and issues of international competition.

Influence of the context on the success of the initiative

In the UK higher education system, there had been perceived difficulties such as a shortage of government resources via HEFCE and the various Research Councils (which offer funding in a competitive fashion), which was considered to be a barrier to more rapid growth in student numbers for teaching, for capital works, and for more research funds. The overseas campus partnerships and innovations turned these perceived barriers in the domestic market into new opportunities for transcending them as a global university through a number of on-going entrepreneurial transformations.

In achieving the internationalisation, the University has been led by a strong institutional leadership, acting as institutional entrepreneurs in spotting new opportunities and creating new organisational capabilities through the negotiation with external stakeholders. International opportunities have been created through targeting international students markets and building the international academic staff community. The mobility of students and staff and the sharing of the value has proved to be the key, alongside the physical development of the international environment, i.e., the development of the international campuses that replicate the 'Nottingham student experience'.

The context was crucial to success. In a positive sense the keen UK government interest in universities being more entrepreneurial and contributing more to economic survival and growth made Nottingham something of a role model and a darling. In the other sense, the contraction in different forms of grant support led naturally to seeking such an initiative. In the case of Malaysia and China rapid growth and economic buoyancy, in marked contrast to slowdown and even contraction of the real economy in the UK, made this fertile ground for development. Money flowed freely when purposes were clear and agreed, and mutual benefit was evident.

This applied to both UNMC and UNNC, nationally and locally. The initiative was in each case handled with cultural and political sensitivity and business clarity. The timing was charmed in that governments in both countries had come to realise that their university systems and teaching were not fit for the purpose of modernising and feeding the knowledge economy that both sought. By playing its cards well, Nottingham was able to exploit this and become a role model and reference point for top quality and relevance for both countries. Such arrangements only became legally possible in China at this time, so Nottingham enjoyed the status of lead innovator and test model for the Chinese.

Outcomes and results

Modest ambitions and targets were set, starting initially just with teaching meant to meet local needs, and moving into research a little later. So far as can be judged, the results met and well exceeded hopes and expectations. No examples were uncovered of serious disappointment or shortfall, as distinct from a slow start in Malaysia. Overcoming difficulties and learning from them developing progressively. Growth was more rapid and perhaps confident in China, but both performed well on all criteria. There was careful progressive development, starting with the most obvious areas of demand and the most willing University schools and departments. Nottingham's most precious asset, along with fine facilities, tends to be defined as reputational. This has gained despite being seen as the obvious area of risk, as vindicated by quality assessment. Student numbers appear set to attain the growth targets set for both initiatives through to 2020. It is evident on the wider canvas that the institutional appetite for other kinds of internationally oriented innovation has not slackened; but nor is it locked into necessarily replicating the same model.

The small sample of four students interviewed spoke highly of Nottingham Ningbo, outlining the merits of the opportunities afforded in terms of the status of a degree from the West, the courses offered (including the lack of courses concerned with politics and Marxist philosophy), the opportunity for extra-curricular activity and the timing of vacations. There were also deterrents including the higher tuition fees, less attention to support for career development by comparison to Chinese universities and limited opportunities for interaction with visiting students from other campuses outside the classroom because of the nature of living arrangements. An indication of the success of Ningbo campus was that three of the students were studying or intending to study at postgraduate level in the UK.

Transferability

Most of what Nottingham has achieved in this large and sustained innovation or transformation is in principle replicable. In the specific sense of the two campuses, the Ningbo campus followed close on the Malaysian and outstripped it, perhaps reflecting the different contexts.

The joint venture approach might be emulated, adapted to different business and regulatory environments. Several senior staff spoke about whether the work should be protected as commercially confidential, knowledge of how to do it kept secret. The common view is that there is little competitive risk: an institution going into this has to learn its own way by doing it; little can be achieved by copying.

At the higher level of generalisation, the way that a university transforms itself, probably all the elements are 'transferable' but the requisites may be lacking. Nottingham's successful innovation and staying power is down to: a highly charismatic and purposeful Vice-Chancellor with practical applied intelligence and patient persistence; whose 20-year reign was followed by the appointment of a close ally and deputy; flanked by a set of strong PVC-level and other senior staff who move around the system rather like the old tradition of senior echelons of the British Public Service, with similar loyalty to shared institutional purpose. A fourth vital element has been the long service of many senior members of the institution as a basis for successful sustainability and continuing evolution.

Part D: Annexes

D1: List of literature used

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D2: List of contributors to the case study

Name	Organisation	Country
Professor Hai-Sui Yu	Pro Vice Chancellor International and Professor of Geotechnical Engineering, University of Nottingham (UK campus)	UK
Professor David Greenaway	Vice Chancellor, University of Nottingham (UK campus)	UK
Professor Jim Devlin	Deputy Dean and Director of Teaching and Professor of Financial Decision Making, Nottingham University Business School, University of Nottingham (UK campus)	UK
Professor Andrew Long	Dean of the Faculty of Engineering and Professor of Mechanics of Materials, University of Nottingham (UK campus)	UK
Professor Roger Woods	Ex-Provost of University of Nottingham Ningbo China and Professor of German, University of Nottingham (UK campus)	UK
Sir Colin Campbell	Former Vice-Chancellor, University of Nottingham (UK campus)	UK
Professor Nick Miles	Provost, China Ningbo Campus, University of Nottingham (China campus)	China
Jiali Zhou Ningbo (UNNC)	International Studies student, now at Nottingham for this Spring Semester [initially a mixed five were invited as a focus group, then four; only one actually came], University of Nottingham (China campus)	China
Xuan Xue	Young Volunteers Association, Finance, Accounting and Management Year 4, University of Nottingham (China campus)	China
Tingting Yu	Fourth year of International Communication, University of Nottingham (China campus)	China
Xiaochen Ge	Graduate of Finance Accounting and Management, working in a foreign enterprise in Shanghai, studied MA at LSE after graduating in 2011, University of Nottingham (China campus)	China
Professor Christine Ennew	Provost of the Nottingham Malaysia campus, Pro-Vice-Chancellor and Professor of Marketing, University of Nottingham (Malaysia campus)	Malaysia
Nick MacDonald	Nottingham City Councillor	UK
Richard Tresidder	Editor of the *Nottingham Post*	UK
Tracy Allan	HEFCE Regional Consultant for Midlands	UK
Cliff Hancock	HEFCE International contact	UK
Daniel Ebinesan	Head of Group Finance, Bousted	Malaysia
Mme Xu	Chair of Wanli Education Group, Ningbo (WEG)	China
Unnamed	Higher Education Evaluation Centre (HEEC), Division of General Affairs	China

The innovative approach to teaching and learning of the Olin College of Engineering (US)

Author: Ms Pam Marcucci

Overview

a. **Drivers:** Olin's development has been driven by challenges from the changing supply of and demand for higher education, including the changing needs of society and employers regarding the numbers, kinds and quality of graduates and the need for universities to bridge the gap between entrepreneurial attitude and entrepreneurial behaviour, and the changing needs and expectations of students in terms of subjects of study and study methods. Main drivers for Olin include the increase in the number of engineering undergraduates; recruiting and training a new generation of engineers able to cope with the current needs of society and the job market through innovative thinking and a problem solving approach.

b. **Strategy:** Olin's strategy is based on the design of an innovative curriculum based on the principles of interdisciplinary, project-based learning and hands-on learning; a more flexible and objective-oriented faculty.

c. **Outcome:** The Olin College of Engineering and the Olin "constructing knowledge" learning model. Olin illustrates innovative teaching and learning in the field of engineering education characterised by a strong emphasis on collaborative curriculum development, project based learning and an interdisciplinary and hands-on approach.

d. **Key factors for success:** Olin's success is amplified by the funding available for the setting up of a new institution over a period of several years, little resistance to innovation, and shared governance.

e. **Implementation challenges:** Main challenges include assessing the quality and impact of the curriculum, replicating the Olin learning model; continuing to innovate, updating and improving the results achieved. Stakeholders' main concerns relate (i) to the ability of the College to maintain the momentum needed to continue being an innovative institution (e.g. ensure that curriculum development, teaching and learning methods are constantly updated and improved) and (ii) to the best ways to measure its impact on engineering education at other institutions.

f. **Main changes:** New selection criteria and procedures; from overspecialisation to multi-disciplinarity; from theory to practice; communication and team skills, better understanding of social, environmental, business and political context; need for continuing education; no academic departments; no tenured faculty members.

g. **Results:** To date, the curriculum at Olin College of Engineering has been successful in preparing its students for careers in engineering and for further study as evidenced by its student satisfaction and the experiences of its graduates. The Olin model is also becoming increasingly attractive to other institutions. While the history of Olin is singular, its model is being adapted and implemented in other very different types of higher education institutions. Indeed, all Olin stakeholders are clear in their belief that the Olin learning model (or parts of it) can be replicated even in institutions serving very different types of students than those served at Olin. Such implementation, however, has to involve attention to organisational change management and the introduction of changes on a pilot basis in order to gain faculty, staff and student support. Olin has achieved international recognition as one of the most innovative institutions in the US; Olin undergraduates are admitted to the best graduate programmes and hired by big companies.

Part A: Setting the scene: introduction, challenges and contexts

A1: Introduction / definition of the innovation initiative

Since 2001 Olin College has introduced a pioneering approach to engineering education based on an interdisciplinary curriculum and a set of innovative practices. The aim of the curriculum and innovative practices is to assist students in actively "constructing" knowledge rather than passively having it "delivered" to them. According to a recent brochure (Olin College 2010), Olin College "seeks to redefine engineering as a profession of innovation encompassing 1) the consideration of human and societal needs; 2) the creative design of engineering systems; and 3) the creation of value through entrepreneurial effort and philanthropy".

The curriculum was designed by the Olin College administration, implemented by the faculty and endorsed by student experiences over the past ten years. Olin's interdisciplinary curriculum is built around the "Olin Triangle" which includes studies in Science and Engineering, Business & Entrepreneurship, and Arts/Humanities/Social Sciences in collaboration with two neighbouring colleges, one specialised in Business (Babson College) and one in liberal arts (Wellesley Colleges). It aims to produce graduates who have robust technical skills, the ability to apply engineering concepts to real problems, an interdisciplinary orientation and extensive design experience.

The collaboration with Babson and Wellesley Colleges not only allows students to take courses in other disciplines, but also to approach and work with students from other fields who have different competences.

Key Features of the Olin Curriculum

The innovative approaches to teaching and learning introduced in Olin's curriculum include:

Constructing knowledge through project-based learning: According to Olin's President, Richard Miller (in an interview with the author June 2013), and "the world has bought into the idea that the purpose of education is to transmit knowledge". He explained that the faculty and administration at Olin do not believe this and its curriculum is built on the premise that the purpose of education is to help students *construct* knowledge through their work on projects, which requires them to apply mathematics, science and engineering principles to real problems. This project based learning approach is thought by Olin to be more effective than passive lecture-based teaching from a pedagogical point of view as it engages students more fully. It is also necessary for practical reasons as engineering evolves so rapidly that the specific content of what future engineers will need to know is impossible to predict. Therefore engineers, like other professionals such as medical doctors, need to be given the tools and experience to continue to learn throughout their careers. The National Academy of Engineering stated in a 2005 report that engineering education has to "arm (students) with the tools needed for the world as it will be, not as it is today". As expressed by President Miller in a 2007 interview (Schwartz 2007), "How can you possibly provide everything (students) need in their knapsack of education to sustain them in their 40-year career?...Learning the skill of how to learn is more important than trying to fill every possible cup of knowledge in every possible discipline."

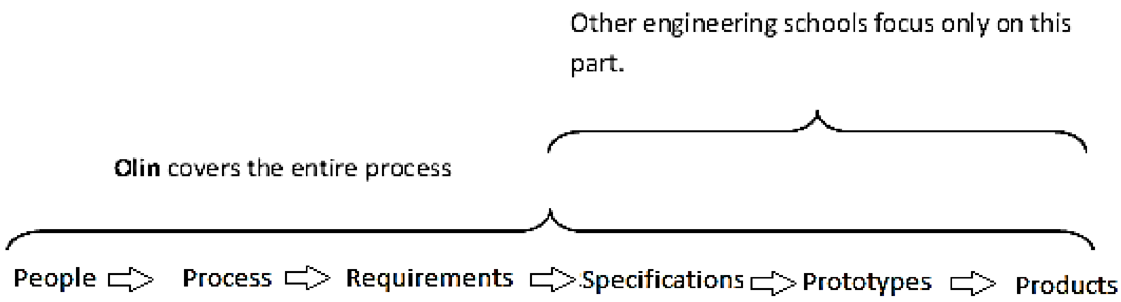
Hands-on approach: Olin is very different from traditional engineering degree programmes in which students spend their first three years studying science and mathematics and wait until their final year to apply what they have learned in a senior project. At Olin, in contrast, students are involved in hands-on design work from their first semester according to Olin's conviction that if you want impact, you have to provide an excellent freshman experience. President Miller made an analogy (interview with writer in June 2013) with music education asking, "What if music students had to wait until they had taken three years of music theory before were they allowed playing their instruments? Just as musicians can start to play their instruments before they understand musical theory, so too can engineering students design things before taking three years of Mathematics and Physics".

In the first-year class "Foundations of Business and Entrepreneurship", for example, students learn how to start a business, by inventing or improving a product. In order to do this, they are given €300,000 which they have to pay back once they have found a buyer for the product. Any extra profit must be given to charity. In their final year of study, students participate in real life business projects with corporate sponsors for developing prototypes for new products.[5]

[5] SCOPE project: In their final year of study, most students carry out a capstone project called SCOPE in which they work in teams of five to seven students with a corporate sponsor to solve a real problem. Olin works closely with companies to develop SCOPE projects that provide value to the sponsors and an educational experience for the students. Each Scope team has a faculty advisor and a dedicated, professionally-equipped work space. This year, for example, a team of Olin students worked with Boston Scientific, a medical device company, to develop a new tool with which to diagnose lung cancer.

Human Centred Design: Another concept inherent in the Olin curriculum is the idea that engineering should be aimed at solving people's problems and giving them what they need, not simply designing something because it is possible to do so. While most engineering schools focus on drawing up specifications and making prototypes (see Figure 1 below), Olin involves students in the process of identifying what is needed before beginning design. Different classes at Olin cover each part of this process. According to Professor Lynn Stein (interview with writer in June 2013), "engineering is not just drawing up specs and making prototypes. It also involves the process of figuring out what is needed by talking with people".

Figure 2: Design process



One course offered in the second year, *User Oriented Collaboration Design*, guides students from the first step (talking to people to identify the problems that need to be solved) through to the fifth step (developing prototypes). In this class, small groups of students choose a category of people (choices range from bike messengers to disabled people confined to wheelchairs) whose quality of life they want to improve. They develop a sociological profile of these people through research and interviews and identify a problem that they have. The students then come up with several ideas for a new technology that are both feasible and address the problem and they propose them to the target group. Once the group has made its final selection, the students do the design specifications and make a prototype of the new product[6].

A 2010 Olin graduate (Leah Engelbert-Fenton, Class of 2010 in telephone interview with writer June 2013) reported that she had incorporated the human-centred design perspective that she learned at Olin in her work where it is not the norm. She said, "As a result, I have received a great deal of recognition and I have been invited to participate in a number of high-level teams that I otherwise would not have had access to".

[6] One group of students came up with an idea for a light-weight bike lock for bike messengers. When they presented their idea to a group of messengers, however, they found out that the messengers generally only leave their bikes unattended for periods of 15 to 20 seconds and that they take it as a point of pride not to lock them, as locks would add weight and slow them down. The messengers preferred the idea for a better, more functional messenger bag and that is what the students ultimately designed.

Student Assessment: Instead of conventional examinations, students are evaluated during a weeklong, institution-wide assessment called *gates* at the end of each year. Assessments include written examinations, oral examinations, and team exercises, and are aimed at assessing each student's mastery of institutionally defined learning objectives as opposed to the objectives of each individual course. It is thought that gates force students to synthesise material among classes and across terms. A student's performance on his/her gate is used to identify areas in which he/she requires additional strengthening.

Innovative Organisational Practices

Alongside its curricular innovations, Olin also introduced practices that are unusual in most higher education institutions in the United States.

No academic departments and no tenured faculty members: One of the most striking differences between Olin and other colleges is the absence of academic departments and the way in which faculty members operate as a single interdisciplinary group. It is felt that the problems that society is going to face in the 21st century are complicated and will not be easy to parse into different disciplines. Therefore, the school sees a need to create systems thinkers who can work across disciplines in teams with multiple points of views and different areas of expertise. In addition, none of the faculty members have tenure. Lawrence Milas, Director of the F.W. Olin Foundation and one of the founding Trustees said (in a telephone interview with the author in June 2013) that having tenure for faculty did not fit Olin's model as "how do we know what we will need in five to ten years as engineering is always evolving". The President of Olin concurred (in a face-to-face interview with the author in May 2013) saying that tenure works against the idea of sweeping change. Instead, faculty members are hired with year-long renewable appointments.

Low tuition fees for students: When Olin was first opened, accepted students were given a full tuition fee scholarship and only had to pay for room and board. This scholarship was subsequently cut in half as a result of the recession in 2008. Nevertheless, every student admitted to Olin receives a half-tuition merit scholarship valued at more than $80,000 over eight semesters, which makes Olin significantly less expensive than other private prestigious colleges/universities. Any additional financial aid is provided according to the student's socio-economic status. One of the reasons for its low cost according to the Chief Marketing Officer, Michelle Davis (in an interview with the writer June 2013) is the school's belief that the students are participating in an experiment that has no guarantees and therefore Olin "does not want to saddle these kids with debt. We want them to give back to the world".

Student selection process: Another significant difference between Olin and other engineering schools is the way in which students are selected. In light of the decreasing size of engineering students as a proportion of the total undergraduate student population over the past 10 years and the high rate at which engineering students transfer to other programmes7, the staff and faculty responsible for creating Olin's student selection process theorised that part of the problem with engineering education was that schools were not attracting the right kind of students and that they were driving out the more creative types such as Bill Gates and Steve Jobs. Olin, therefore, decided to do recruitment and selection differently than most colleges and universities and created "Candidates Weekend" during which selected applicants visit the campus in groups of 70 for a two day period8. As the educational approach at Olin centres on making things and working in groups, the selected applicants are broken into groups of five. Each group is assigned three Olin faculty or staff members most of whom have not seen the applicants' academic scores. The groups are then given three hours to do a project. Similar exercises are held throughout the weekend. At the end of the weekend, the Olin faculty/staff score each applicant separately on a scale of one to five and then compare their scores with one another. They generally arrive at very similar conclusions regarding the suitability of the various students for a programme like Olin's. They do not over-emphasise grades, but are looking for smart students who have multiple interests and talents. Of the 240 students who attend Candidates Weekend, 130 are offered places in the entering freshman class.

Objectives and outcomes of the initiative

While the original intent of the College was to re-think the undergraduate engineering curriculum that it would use in educating a new kind of engineer, it is now developing what it refers to as a "learning model" based on what it has learned in its years of operation. According to President Miller (in an interview with the author in May 2013), "Olin cannot be a catalyst for change in engineering education without engaging with other institutions". Its second decade of operation is, therefore, aimed at creating a movement for change in higher education using the principles that they developed. They are operationalizing this vision through collaborations with other institutions.

One issue mentioned by both President Miller and Mr. Milas in their respective interviews is the difficulty of identifying which metrics should be used to assess the "success" of the school. While Olin graduates have an excellent track record in terms of employment (see Section C), incomes and further study at prestigious institutions and Olin has been successful in spreading its learning model to other higher education institutions (HEIs), its real impact on undergraduate engineering education in general and on engineering as a profession will only be observable in the longer term.

A2: Understanding of the context

[7] Only about half of the students who start in an engineering programme, graduate in engineering.
[8] There are three such weekends each year so that 240 candidates have the opportunity to attend.

The fact that Olin is a small, private and well-endowed institution was critical to its developing the curriculum, but not to its further dissemination and implementation elsewhere. Olin is a small (only 346 students) institution. It is very competitive to enter and has far more applications for places than it can accommodate. Only 19 per cent of applicants are ultimately accepted. Its students are bright as demonstrated by their scores on the national ACT and the SAT tests and class ranks in secondary school[9], though they are not always those that score the highest on standardised tests. All of Olin's faculty members have doctorate degrees, many from top schools including MIT, Harvard and California Technical Institute.

Olin College of Engineering was ranked as one of the United States' best 377 institutions for undergraduate education by the Princeton Review, an education services company, in its publication, *The Best 378 Colleges: 2013 Edition*. Only about 155 of America's 2,500 four-year colleges and three colleges outside the U.S. are profiled in the book. In addition, Olin College is ranked number six in the *US News and World Report* 2013 ranking of the best undergraduate engineering programmes in institutions with no doctoral programme.

Olin College was created in 1997 with an endowment from the F.W. Olin Foundation when the Foundation became convinced that nothing short of a fresh start in a new institution would address the problems inherent in undergraduate engineering education. The Director of the Olin Foundation, Lawrence Milas, is quoted in 2007 as saying that "he had grown frustrated with a process that helped schools but didn't change engineering education, which he says he thought was in a rut. He wondered whether it might be a good idea to fold the foundation and devote its assets to the creation of a new college" (Schwartz 2007). The Foundation ultimately decided on this course of action and according to Milas (in the June 2013 interview with the author), "starting in 2000, the faculty and staff were given two years without students and teaching responsibilities to strategically prepare the curriculum and develop institutional policies". Guided by the National Science Foundation reform recommendations and best practices collected from around the world, they examined all aspects of college life to identify better ways of delivering undergraduate engineering education.

Olin received its Education Charter from the Commonwealth of Massachusetts in 1997 and is accredited by the New England Association of Schools and Colleges, Inc. and by the Engineering Accreditation Commission of ABET, the recognised U.S. accreditor of college and university programmes in applied science, computing, engineering and technology. While graduates of Olin may take the Fundamentals of Engineering exam and pursue licensure as a Professional Engineer by the National Council of Examiners for Engineering and Surveying (a credential that is required if they want to offer engineering services directly to the public as a

[9] Admitted students usually rank within the top 10% of their secondary school graduating class. Their middle 50% SAT scores are 2100-2280 out of a total possible score of 2400 and their middle 50% ACT scores are 33-35 out of a total possible score of 36.

consultant), most enter graduate school or are employed upon graduation. According to the National Academy of Engineering (2005), the Bachelors of Science degree in engineering should be considered as pre-engineering or "engineer in training" degree rather than a professional programme.

In terms of its governance, the College subscribes to the fundamental principle in higher education of shared governance. The faculty members and students have been very much involved in decision-making and planning since the College began. Ultimate responsibility for the quality and integrity of the College is held by the Board of Trustees, which consists of 15 members, including two of the three surviving Directors of the F. W. Olin Foundation. The President of Olin College is an ex-officio member of the Board. The College also has a President's Council, which is an advisory group of distinguished advisors who counsel the President on a full range of issues relating to curriculum, student life, administration and finance, governance, and admission.

As a result of a construction delay, the campus was not ready for the first batch of incoming students in the autumn of 2001. The school, therefore, decided to admit only 30 students to experiment with the main components of the curriculum that was in the process of being developed. The programme was organised into six modules or what President Miller calls "challenges" (projects to design, build and demonstrate) each of which was used to test some aspect of the envisaged curriculum. It also included a four-week trip to France to investigate international aspects of the programme on the campus of Georgia Tech Lorraine in Metz. According to a faculty member, Lynn Stein (interviewed by author in May 2013), faculty learned that it is not necessary for students to have taken two years of calculus and physics before designing something and that the making of the thing was what made the students WANT to learn calculus and physics so they could improve their designs. They found that the students were considerably more capable than most people think. Other lessons that they learned according to President Miller (May 2013 interview) was that constructing knowledge is far more potent than learning it in a book, that student engagement is essential for learning and that project-based learning was considerably more engaging than lecture based learning. These lessons were fed into the curriculum development process by the Curriculum Decision Making Board.

Parts of the innovation have subsequently been adapted for use in other very dissimilar higher education institutions via training and partnerships with Olin. For example, the University of Illinois Urbana-Champaign is a large state university and The University of Texas at El Paso caters to commuter students. Notwithstanding these contextual differences, the partner HEIs have successfully adapted and implemented Olin's learning model.

A3: Challenges and identification of the specific drivers behind the innovation initiative

Olin College was created to address the fact that America is not graduating enough talented engineers as demonstrated by the shrinking share of undergraduate engineering students as a percentage of total Bachelor degree students. The founders suspected that this is a result of the nature of engineering education (ever increasing specialisation and loss of its interdisciplinary approach, focus on theory as opposed to practice, and emphasis on research as opposed to teaching) that is driving the most talented students away from the field as demonstrated by the fact that only half of the students who start off in engineering nationally eventually graduate in it, while the other half moves to other disciplines (Radio Boston July 2012).

These problems had been recognised throughout the 1990s by such organisations as the National Science Foundation and the National Academy of Engineering. The National Science Foundation called for such systemic changes as shifting from disciplinary thinking to interdisciplinary approaches, for increased development of communication and team skills, for greater consideration of the social, environmental, business, and political context of engineering; improved student capacity for life-long learning; and design throughout the curriculum. Nevertheless, the many papers that were written[10] and conferences that were held did not have the hoped for impact on engineering programmes. Institutionally entrenched interests were resistant to change, especially change that involved professors acting more like coaches than experts in their interactions with students.

According to President Miller (June 2013 interview), engineering education is more interested in producing professors who excel at research and publishing than in producing engineers. Coupled with this trend, he notes that there is a growing conception of engineering as a body of knowledge, rather than as the process that he asserts it is. Olin's curriculum was designed from scratch to address these problems and fundamentally change the way students were taught to be engineers.

Olin's curriculum responds to challenges from the changing supply of and demand for higher education including the changing needs of society and employers regarding the numbers, kinds and quality of (engineering, in this case) graduates and the need for universities to bridge the gap between entrepreneurial attitude and entrepreneurial behaviour. Olin's challenges also include the changing needs and expectations of students in terms of subjects of study and study methods.

[10] National Academy of Engineering. (2005). Educating the Engineer of 2020. Adapting Engineering Education to the New Century. Washington, DC: National Academy of Engineering.

The F.W. Olin Foundation decided the best way to maximise its impact was to help create a college from scratch that can address these emerging needs. The college's first and foremost goal in its first decade of operation was to attract talented perspective students and produce more practice-oriented engineers.

As it moved into its second decade, the college decided to work to create a movement for change in engineering education across the United States and internationally using its "learning model". According to the President, it has seen that it cannot be a catalyst for change in engineering education without engaging with other institutions.

Part B: The higher education innovation system: functions, components and relationships

Part B studies the innovative curriculum at Olin College along the lines of the higher education innovation system: components, functions and relationships.

B1: Analysis of the functions

The innovation at Olin College has to do with the education function of higher education. One of the reasons behind its establishment was to re-balance the then prevalence of research over teaching in engineering and the growing (in the eyes of Olin's founders) conception of engineering as a body of knowledge as opposed to a process of framing and solving problems.

Within the education function, of particular relevance are teaching and learning and curriculum development, undertaken in innovative ways, entailing the construction of knowledge through projects, as opposed to its being imparting to students, interdisciplinarity, as opposed to ever increasing specialisation, a hands-on approach, as opposed to exclusive teaching of natural sciences and math with few opportunities for application.

Olin's innovative curriculum has also had a significant impact in terms of its third mission and has generated considerable entrepreneurship among its students as evidenced by the significant number of students who start businesses while in school or following graduation and graduates and has considerably influenced engineering education at other institutions (see section 3).

B2: Analysis of the components

Students are the group that is most affected by the innovative initiative at Olin. They are clients (consumers) who decide together with their parents whether to apply for and attend Olin (so they are also veto players to a certain degree) and if they do, they are its beneficiaries. Students have also been involved in driving the initiative almost from the beginning and are well aware of their pioneering role. A 2010 graduate said that one of the things that attracted her to Olin was the opportunity to contribute to its development.

Employers are similarly affected except as clients/consumers. They benefit to the extent that the Olin graduates have the skills that they need in their businesses. By hiring the students, they drive and validate the initiative, but they can also conceivably be veto players when they do not hire Olin graduates.

Graduates of Olin are beneficiaries, but also drivers as they help other Olin graduates find jobs and serve as ambassadors for Olin's learning model. Two alumni (interviewed by the author by telephone in June 2013), Leah Engelbert-Fenton and Sam Young, said that Olin prepared them for the world of work. While they acknowledged that graduates of other engineering programmes might have more technical knowledge, they felt that they had been given a grounding that made it possible for them to learn what they did not already know. Sam Young recounted how she is working at an apps development company. She had not known very much about programming when she started as she had majored in mechanical engineering, but she had the confidence from Olin that she would be able to jump in and learn what she needed to know. Since 2011, Olin has had an alumna of the first graduating class on its Board of Trustees.

The Olin Foundation was probably the most significant driver of the initiative and the main decision maker at the beginning of the process. According to Lawrence Milas (June 2013 interview), the Foundation considered three options to pursue its goal of improving engineering education: putting its resources into an existing engineering school, opening an engineering school at an existing institution or founding a new engineering school. The foundation chose to found a stand-alone state of the art undergraduate engineering school so it would not have to change an existing culture. As the school was developed and especially, once it had been in operation for several years, the Foundation passed these roles on to the administration especially the President that it had chosen. Since he was hired, the Olin President has been a significant driver and decision maker.

Table 4: Actors involved in the initiative

	Clients	Beneficiaries	Drivers	Decision makers	Facilitators	Veto players
Students	✓	✓	✓			✓
Employers		✓	✓			✓
Graduates		✓	✓			
Admin			✓	✓		
Olin Found			✓	✓		
Board of Trustees			✓	✓		
Faculty members			✓		✓	✓
Corporate partners		✓			✓	

Academic partners*		✓			✓	
Model partners**	✓	✓		✓		

**Academic partners include Babson and Wellesley.*
***Model partners include those with which Olin is co-developing curricula.*

The Board of Trustees at Olin has been a driver of the initiative as well as a decision maker responsible for the governance procedures and oversight. Faculty members at Olin have been important drivers of the initiative as they were involved from the beginning in the design of the curriculum. They can also be veto players as they are sometimes uncomfortable with the learning model that is used. Corporate partners who participate in internships and Olin's final year SCOPE programme are beneficiaries of Olin's education model as well as facilitators as their agreeing to host student groups adds legitimacy to the school.

Olin's academic partners including Babson and Wellesley colleges are also beneficiaries as their students can take classes at Olin and they can offer joint co-funded activities. They are also facilitators as Olin does not have to offer the classes that its students can take at the other two institutions. Model partners such as the University of Illinois and University of Texas at El Paso and their faculty members are clients of Olin as they participate in the summer programmes held at Olin and benefit from Olin's consulting services. They are also beneficiaries given that their engineering programmes are strengthened by their collaboration with Olin. They are decision makers in their own institutions when they decide whether to implement some of the innovations.

Table 2 shows the main actors/stakeholders, the level at which they operate (macro, meso and micro*), their roles and responsibilities as defined in Table 2 and outlines the activities that the stakeholders carry out in relation to the innovation.

Table 5: Actors/stakeholders, level of operation, roles and responsibilities and activities

Actor/stakeholder components	Level (macro, meso, micro)	Roles	Activities
Students	Micro	clients, beneficiaries, drivers, veto players	Learning, providing feedback on curriculum model
Employers	Micro	beneficiaries, drivers, veto players	Hiring graduates
Graduates	Micro	beneficiaries, drivers	Working
Admin	Meso	drivers, decision makers	Policy making and day-to-day operations

Olin Foundation	Macro	drivers, decision makers	Initial school creation and policy making
Board of Trustees	Meso	drivers, decision makers	Policy making
Faculty members	Micro	drivers, facilitators, veto players	Teaching, contributing to adaptations of curriculum model
Corporate partners	Meso	beneficiaries, facilitators	Providing practical experience for students
Academic partners*	Meso	beneficiaries, facilitators	Providing business and liberal arts courses to Olin students
Model partners**	Meso	clients, beneficiaries, decision makers	Working with Olin to develop and implement curricular improvements in their institutions.

**defined as follows: micro – involved in day to day operations; meso – involved in decision and policy making; macro involved with Olin outputs such as students and graduates or Olin consulting on curriculum development.*

B3: Analysis of the relationships

When looking at the relationships between the different actors involved with the innovative curriculum at Olin, it must be noted that several of the relationships were, in fact, only established after the innovation took place. For example, the Board of Trustees was only really established once the innovative curriculum had been developed, the two neighbouring institutions (Babson and Wellesley) only become involved once Olin was operational and the relationship between Olin and corporate partners and employers was only established once the curriculum was developed and being implemented.

Table 6: Relationships between actors

Actor 1	Actor 2	Relationship	What changed?
Olin Foundation	Olin College	Collaboration Costs: significant financial investment Benefits: success of College in furthering foundation goals	Substitution
Faculty members	Olin College	Collaborative Costs: risk of working at a new HEI Benefits: opportunity to be involved in developing curriculum; salary	Became even more collaborative as they embarked on an untried experiment together Costs: continued risk Benefits: opportunity to be involved in developing curriculum; salary

Board of Trustees	Olin College	NA as did not exist before innovation	Collaboration, networking Costs: none Benefits: opportunity to be involved in college guidance
Babson and Wellesley Colleges	Olin College	NA as did not exist before innovation	Collaboration Costs: accommodating additional students Benefits: sharing resources
Students	College staff and faculty	Collaborative Costs: low cost Benefits: design education; collaboration on curriculum; returns on education	Service/consumer; collaboration as they embarked on an untried experiment together Costs: higher costs Benefits: design education with high returns
Employers	Olin College	NA as did not exist before innovation	Service/consumer relationship; collaboration Costs: none Benefits: pool of talented graduates with unique skills
Corporate partners	Olin college	NA as did not exist before innovation	Funding; collaboration; networking Costs: time and effort involved with working with student SCOPE teams Benefits: assistance in solving problems by young, dynamic thinkers
Model institutions		NA as did not exist before innovation	Service/consumer; collaboration; networking Costs: financial costs of collaboration Benefits: improved curriculum and educational potential of their engineering programs

As to the relationships between the other actors, Olin College benefited from the Olin Foundation's investment both financially and in terms of the opportunity it had to create an innovative engineering programme that could have a national impact on engineering education. The Olin Foundation, in turn, benefited in its quest to change engineering education and in leaving a long-term legacy benefiting the engineering profession.

Prior to the implementation of the curriculum, the relationship between the faculty members and Olin College was collaborative as they worked together to develop what would become the Olin College curriculum. At the same time, the faculty benefited financially from the relationship. Similarly, the selected students in the project year had a collaborative relationship with Olin in that they also were involved in creating the curriculum.

Following the implementation of the curriculum, several relationships were established such as those between the Board of Trustees and Olin's administration, between Babson and Wellesley Colleges and Olin, between employers and Olin, between corporate partners and Olin and between model partners and Olin and others changed or strengthened as shown in Table 3.

The relationship between the Foundation and College became one of substitution when the Foundation closed, transferring additional money and responsibility to Olin College. The relationship between the faculty members and Olin College became even more collaborative as they embarked together on piloting the curriculum. Olin College pays faculty members to use the innovative curriculum covering its costs with endowment and tuition fee resources. Expected returns are a better engineering curriculum that creates better engineers and more prestige.

Students pay for and benefit from the curriculum in terms of their experience while in school and the employment potential it offers to them after they graduate.

B4: Cross-elements analysis

Mapping the system and stakeholders

The majority of relationships between stakeholders have a collaborative element (yellow) indicating participatory decision making and cooperation. There are also a number of service/consumer relationships (green) such as those between students and Olin College, between students and faculty, between students and corporate partners and between Olin and its model partners and potential employers of its graduates. The only substitution relationship is between the Olin Foundation and the college, which took on the Foundation's objectives and its funds. Funding relationships are also found between students and the college, faculty and the college and corporate sponsors and the college.

The curriculum has had an impact on all of the main actors. The Olin Foundation closed after the curriculum had been piloted at Olin College for two years. Mitch Cieminski, a student (interviewed by author by telephone in June 2013) who had just finished his first year at Olin claimed that: "the first semester embodies what the curriculum tries to do – to teach students to be fearless, to take risks and to have confidence in their ability to solve problems". Similarly, the recent graduate, Sam Young, said, "I learned to break problems apart in order to solve them and this approach has been recognised at work".

Faculty members have the opportunity to implement a challenging curriculum which requires them to coach students rather than to lecture to them. The curriculum has a strong impact on students as it influences their approach towards engineering in their professional lives and further education. It also has an impact on employers as it supplies a different kind of engineering graduate. The curriculum offers a tested learning model to partner faculty members and institutions that they can adapt to and implement in their institutions. The curriculum has an impact on corporate partners as they benefit from the ways the student teams approach their problems. The interdisciplinary elements of the curriculum have an impact on Babson and Wellesley Colleges as they have additional demand for classes from Olin students.

Key:

Blue	Funding (role)
Red	Driving (role)
Yellow	Collaboration/conflict (relationship)
Green	Service/consumer (relationship)
Orange	Substitution (relationship)
Purple	Networking (relationship)

Note: In the figure below the Olin Foundation is strikethrough since it was closed down in 2005. Before it was closed it played a central role for macro level policy making as indicated in the schematic representation.

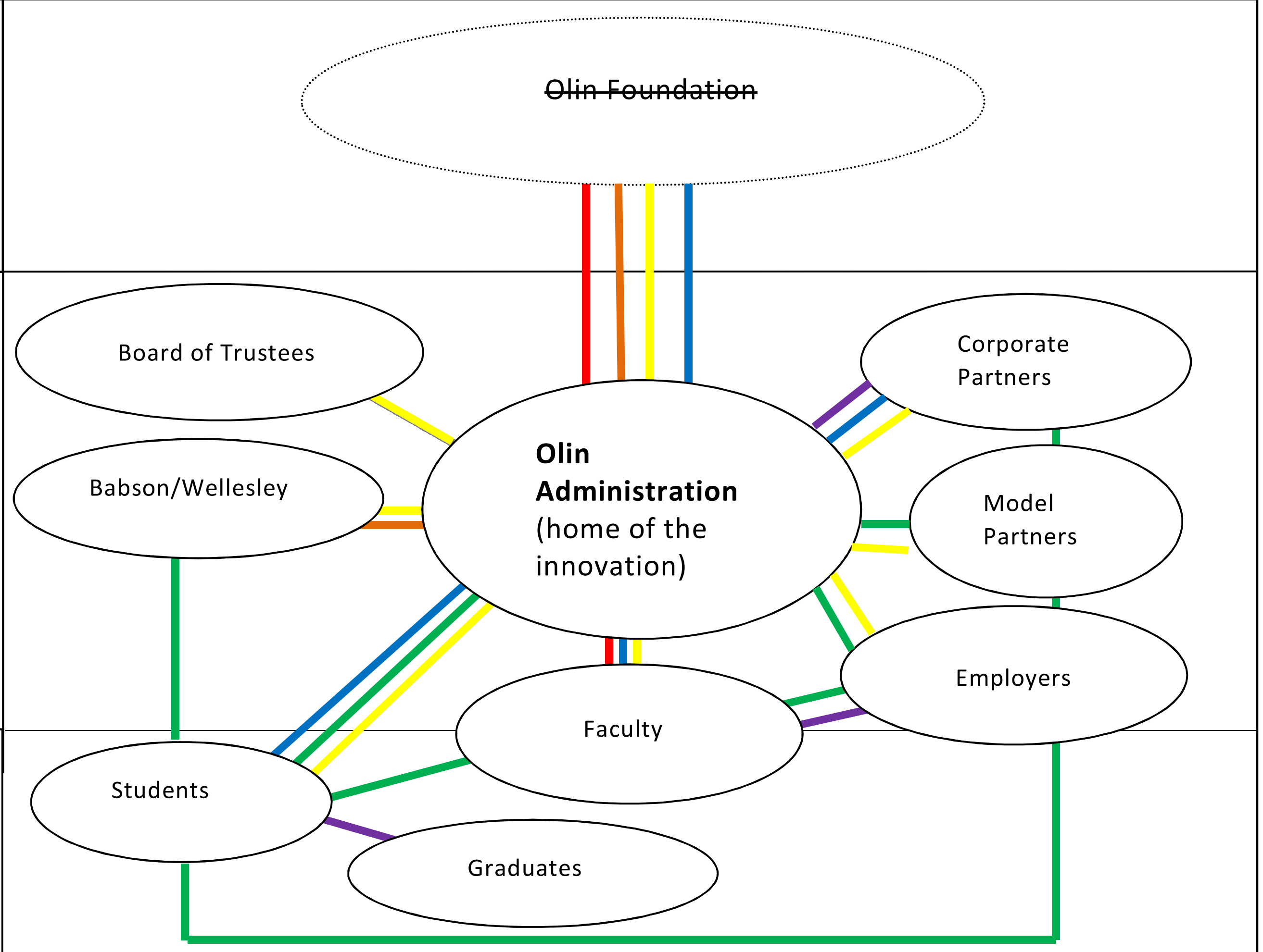
Figure 3: Higher education innovation system map in the case of Olin College

Function to which innovation is related: primarily education, but also the College's third mission of encouraging student entrepreneurship and influencing engineering education nationwide. Aim of innovation: to provide a new kind of engineering education that attracts and retains more students and produce engineers capable of solving complex 21st century problems.

Macro Level: Policy making

Meso Level: institutional

Micro Level: individual



Context and challenges to innovation: include sustaining a culture of change at all institutions and resistance to change at other engineering schools.

Part C: Outcomes, assessment and conclusions

C1: Conclusions: Assessment of outcomes in terms of expected and unexpected consequences

Barriers and bottlenecks

According to Lawrence Milas (June 2013 telephone interview), there were no real barriers other than logistical (building delays) in implementing the new curriculum. The school was able to get both the Massachusetts Department of Education and the Community behind it and had the support of two established academic institutions, Babson and Wellesley Colleges. Most importantly, the students and faculty members were eager to be part of an experimental learning model. Olin has been well-accepted by other engineering schools as demonstrated by its on-going partnerships with the University of Illinois, Duke University, and the University of Southern California among others organising international conferences and joint programme.

What continues to challenge the College, however, is sustaining a culture of change or as articulated by Lawrence Milas (in a June 2013 telephone interview with the author), "never believing that you have it totally figured out." This challenge is tied to another one that the college is grappling with - how to best assess whether it is meeting its goals of producing engineering innovators and transforming engineering education. While the outcomes of its graduates are positive and the school is gaining international recognition as one of a select group of the most innovative institutions in the United States (it was featured at the UNESCO World Conference on Higher Education and the World Bank Knowledge Economy Forum as an example of innovation in education), it is also interested in assessing its impact on engineering education at other institutions. To this end, as part of its grant from the Argosy Foundation, Olin is setting up an evaluation process to monitor and assess methods of fostering sustainable institutional change.

Influence of the context on the success of the initiative

The context in which the Olin College curriculum was developed was a factor in its success, although it is not necessary that the context be replicated for the innovative learning model tested at Olin be implemented at other institutions. Olin has several partnerships with other institutions where parts of the curriculum have been successfully adapted and implemented. At the University of Illinois for example, two signature Olin courses, User-Oriented Collaborative Design/ID8 and Foundations of Business and Entrepreneurship, were adapted and are now offered as elective options to all engineering students.

According to the student and graduates interviewed by telephone in June 2013[11], the Olin curriculum prepared them to tackle complex problems and to not be afraid of failure. In some cases, while it was obvious to them that their peers were coming from different places and some may have been technically superior, the Olin graduates said that they felt that they are more confident learners and problem solvers and that these skills are highly valued in the world of work. They also felt that they have an intrinsic motivation that is quite different from their peers[12].

The school tracks its graduates and collects employment and further academic study information (see Table 4). According to its website, 26 Olin graduates have received postgraduate fellowships such as the Fulbright and National Science Foundation and about a third are enrolled in advanced degree programmes at some of the best graduate programmes in the country (Berkeley, Carnegie Mellon, Cornell, Harvard, MIT, Stanford and others). More than half are employed and others have continued on with entrepreneurial start-ups they created at Olin.

Table 7: Where do Olin alumni go after they graduate?

Top Employers		**Top Graduate Schools**	
Employer Name	**Number of graduates hired**	**School Name**	**Number of students who attend or attended**
Microsoft	42	Harvard University	23
Athenahealth	15	MIT	18
Google	12	Carnegie Mellon University	14
Navy	9	Babson College	11
Rockwell Automation	8	Stanford University	11
Boeing	7	Cornell University	8
Pocket Game	6	University of Washington	6
Twitter	6	University of California Berkeley	5
Bluefin Robotics	5	Virginia Tech	4
Raytheon	5	University of California Santa Barbara	4
Synapse Product Development	5	University of Illinois Urbana-Champaign	4
Akamai	4	Worcester Polytechnic Institute	4
Energy Solutions	4		
Facebook	4		

[11] Mitch Cleminski, a student who had just finished his first year at Olin. Sam Young, a recent graduate (she graduated in May 2013). Leah Engelbert-Fenton, a 2010 graduate of Olin.

[12] The student who had just finished his first year at Olin said that by the end of the year, he was working hard on his projects not only because he wanted a good grade, but because he wanted his projects to be the best they could be.

GE	4		
Intuit	4		
Massachusetts General Hospital	4		
Pivotal	4		

Source: Based on results of surveys administered by Office of Post-Graduate Planning between 2006 and July 2013 (available on Olin College website).

Despite the time consuming and great effort that the college devoted to developing the curriculum, it is not meant to be immune from changes and updating. The curriculum is to be revised and re-designed every seven years after a comprehensive assessment at the institutional level.

Transferability

During its first decade of operation, Olin College focused mainly on using its curriculum to attract and teach a new generation of engineers and to test the impact of its curriculum. As it started its second decade, it decided to use its learning model to create a movement for change in engineering education. According to President Miller (interview with author June 2013), the College has seen that "it cannot be a catalyst for change in engineering education without engaging with other institutions". He asserted that if its learning model can only be successful on a small well-funded campus then it is not working and that they have worked hard to make it scalable beyond their gates.

While the history of Olin University is singular as it was built on a Foundation start-up grant of more than $400 million, the educational model has been adapted and implemented at other very different types of higher education institutions. Stakeholders[13] consulted at the University of Illinois, for example, believe that the Olin learning model (or parts of it such as the hands-on project-based learning approach and user-oriented project design) can be replicated even in institutions that serve very different types of students.

The longest-running example of this is Olin's collaboration with the University of Illinois at Urbana Champaign in which they explore ways to scale up the curricular innovations pioneered at Olin with only 300 students to an institution with a much larger student body of more than 5,300 undergraduates. The collaboration started five years ago when Olin was contacted by the University of Illinois, where some faculty members in the school of engineering had set up IFoundry, a space to experiment with new interdisciplinary curriculum models that could transform engineering education. Together with the IFoundry, Olin adapted two signature courses in design and entrepreneurship to Illinois: User-Oriented Collaborative Design/ID8 and Foundations of Business and Entrepreneurship. These courses are offered as elective options to

[13] Telephone interviews in June 2013 with David Goldberg, iFoundry Co-Founder, University of Illinois and Professor Charles Tucker, Professor at University of Illinois

all engineering students, and may count as Liberal Education requirements in a students' course program.

iFoundry also worked with Olin faculty to design a one-credit course, Illinois Engineering Freshmen Experience, which all first year engineering students would take to enhance their autonomy, mastery, and purpose. Now stakeholders say that they see the "Olin Effect" as students are taking control of their learning. The experience of implementing new curricular elements at the University of Illinois revealed that the process is as much about organisational change management as it is about curricular reform. The new courses could not simply be announced. The stakeholders, including faculty members and students, have to be convinced to participate in the pilot and then shown that the innovation works. It is particularly important to get students on board as they then become messengers and drivers for the innovation.

The two institutions also carry out joint research, exchange faculty and students, and share curricula, content and pedagogical materials. As part of the Olin-Illinois Exchange Program (OIX), students at Illinois can spend up to two semesters at Olin College, pursuing courses that are fully transferable to Illinois. Similarly Olin students can study at the University of Illinois.

Olin College is also working with the University of Texas to apply elements of its learning model to what is mainly a commuter college. They decided to start with one programme (the Bachelor of Science in Leadership Engineering), because it will be easier to expand once proven successful. While the University of Texas at El Paso College of Engineering has been developing the programme since 2008, it recently signed a partnership agreement with Olin College to develop its curriculum, train, and align the BSLE programme with Olin's ten years of development in changing the face of Engineering Education.

Olin has recently signed an agreement with INSPIR, a private higher education institution in Brazil, to help with the setting up of an engineering school using some of the learning principles used at Olin.

In 2009, the College developed the Initiative for Innovation in Engineering Education (I2E2), to provide coordination, leadership, and a single point of contact for both internal and external conversations aimed at fostering innovation and change in engineering education. Olin's I2E2 offers faculty workshops to co-design curricula and empower academic innovators; short- and long-term faculty exchanges to learn, develop and deliver innovative curricula; and customised consulting to help institutions recognise, develop, and meet their needs for innovation.

Olin has also recently created a position for a Marketing Officer who is charged with reaching out to donors and educating people about what Olin is doing to transform undergraduate engineering education.

Olin received a $1.3 million grant from the Argosy Foundation for faculty exchanges with the goal of effecting wider reform on campuses across the country. Participating faculty, known as Argosy Olin Fellows, work on their projects for up to a year while at Olin, enabling them to experience first-hand the school's curriculum. Teaching opportunities – such as co-teaching in some of Olin's distinctive courses – are encouraged and may also include piloting of courses developed during the residency for the home institution. Olin faculty and students benefit from the fresh perspectives that visiting professors offer. As part of the program, Olin faculty also spent time at the partner campuses to help with the implementation of their planned curricular innovations.

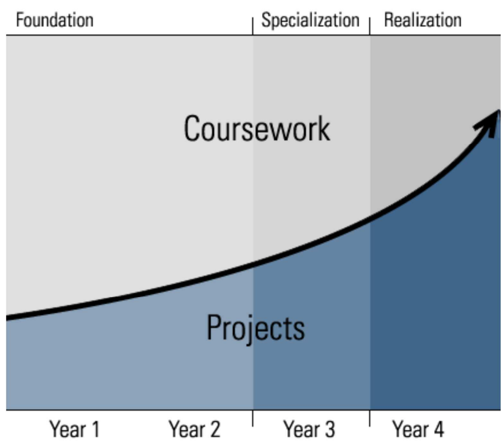
Part D: Annexes

D1. Description of the Olin curriculum

The Olin curriculum consists of three phases:

- *Foundation (first two years of the four-year programme)*, which emphasises mastering and applying technical fundamentals in substantial engineering projects;
- *Specialization (third year)*, in which students develop and apply in-depth knowledge in their chosen fields; and
- *Realization (final year)*, in which students bring their education to bear on problems approaching professional practice.

Figure 4: Structure of the Olin curriculum



Source: Olin College website

In all three phases of the curriculum, students are engaged in interdisciplinary engineering projects that, under the guidance of their professors, require them to put theory into practice, to put engineering in context, and to develop teaming and management skills. Project based learning puts students in the role of *designers* of problem solutions and faculty in the role of *coaches*. As a student progresses, these projects become increasingly open ended and authentic. Figure 1 shows the increasing emphasis on projects and decreasing emphasis on coursework in the Olin curriculum as a student moves from foundation to specialization to realization.

Table 8: Required courses at Olin College

	Course Title
Math and Science	Modelling and Simulation of the Physical World
	Vector Calculus
	Linear Algebra
	Probability and Statistics
	Foundations of Modern Biology (with laboratory)
	Chemistry/Materials Science - One of: ▪ Introduction to Chemistry (with laboratory) ▪ Materials Science and Solid State Chemistry (with laboratory) ▪ Organic Chemistry (with laboratory)
	Physics – One of: ▪ Electricity and Magnetism ▪ Mechanics ▪ By petition only: o Modern Physics o Solid State Physics o Advanced Classical Mechanics
Engineering	Modelling and Control
	Real World Measurements
	Principles of Engineering
	Engineering Capstone - One of: ▪ SCOPE ▪ Affordable Design and Entrepreneurship (ADE)
Design	Design Nature
	User-Oriented Collaborative Design
	Design of Depth Course – One of: ▪ Sustainable Design ▪ Human Factors and Interface Design ▪ Distributed Engineering Design ▪ Product Design and Development ▪ Design for Manufacturing ▪ Systems ▪ Affordable Design and Entrepreneurship (ADE)

All students must complete a minimum of 120 credits in order to graduate from Olin. These 120 credits must satisfy both general requirements in the areas of math and science, engineering and design as well as programme-specific requirements. The general requirements (14 courses listed in Table 1) are taken by all students regardless of their degree or concentration.

Students at Olin chose between three main degree programmes: Electrical and Computer Engineering, Mechanical Engineering and Engineering and between five concentrations (BioEngineering, Computing, Design, Materials Science or Systems) within the latter. Each programme has its own requirements. General Requirements and Program-Specific Requirements are further broken down into Distribution Requirements that specify the minimal number of credits that must be completed in Engineering, Math, Science, Arts, Humanities and Social Sciences and Entrepreneurship and Course Requirements that specify which courses must be completed. A sample four-year curriculum from the Olin website is shown in Figure D2.

Figure 5: An example of one of many ways a student might progress through the four-year programme

1st YEAR

1st semester	**ENGINEERING**	**MATH & SCIENCE**		**ENGINEERING**	**ARTS**	
	Compartment Systems	Modelling and Simulation of the Physical World		Designing Nature	Arts, Humanities, Social Sciences Foundation	= 15 credits
2nd semester	**ENGINEERING**	**MATH**	**SCIENCE**	**SCIENCE**	**E FOUNDATION**	
	Spatially distributed systems	Vector Calculus	Physics	Biology or Materials Science	Foundations of Business and Entrepreneurship	= 17 credits

2nd YEAR

1st semester	**ENGINEERING**	**MATH**	**SCIENCE**	**AHS**	
	Principles of engineering	Linear algebra Probability and stats	Chemistry or math and science, or materials science	Arts, Humanities, Social Sciences	=16
2nd semest	**ENGINEERING**	**MATH**	**ENGINEERING**	**ENGINEERING**	
	Program specific engineering	Math or science	Program specific engineering	User-Oriented collaborative design	=16 credits

3rd YEAR

1st semester	**ELECTIVE**	**ENGINEERING**	**ENGINEERING**	**AHS**	
		Program specific engineering	Program specific engineering	Arts, Humanities, Social Sciences	= 16 credits
2nd semester	**ELECTIVE**	**ENGINEERING**	**ELECTIVE**	**AHS/E!**	
		Program specific engineering		Arts, Humanities, Social Sciences or Entrepreneurship	=16 credits

4th YEAR

1st semester	**SCIENCE OR MATH**	**SCIENCE OR MATH**	**ENGINEERING**	**ENGINEERING**	**AHS/E!**	
	Science or math		Design Depth	SCOPE	Arts, Humanities, Social Sciences or Entrepreneurship	= 16 credits

2nd semester	ENGINEERING	ENGINEERING	ENGINEERING	AHS/E!	
	Olin self-study	Program specific engineering	SCOPE	Capstone	= 16 credits

Source: Olin College website

D1: List of literature consulted

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D2: List of contributors to the case study

Name	Organisation	Country
Dr. Richard Miller	President of Olin College	United States
Dr. Lynn Stein	Professor, Director of the Initiative for Innovation in Engineering Education at Olin College	United States
Michelle Davis	Chief Marketing Officer at Olin College	United States
Mr Lawrence Milas	Founding Trustee of Olin	United States
Professor Charles Tucker	Professor at University of Illinois who is involved with the UIUC-Olin partnership	United States
Dr. David Goldberg	Co-founder of iFoundry at the University of Illinois	United States
Leah Engelbert-Fenton	2010 graduate of Olin College	United States
Sam Young	A student who graduated in May 2013	United States
Mitch Cieminski	A student who had just finished his first year	United States

The macro-level blended learning at the Bavaria Virtual University (Germany)

Author: Mr Simon Broek

Overview

a. **Driver:** The development of the Bavarian Virtual University (BVU) has been driven by (i) challenge from the changing supply of and demand for higher education. Specifically, drivers include the growing overall demand for higher education, the growing student diversity with growing demand for more flexible courses delivery, and the maintenance of the university through local demographic decrease.

b. **Strategy**: The BVU strategy makes use of e-learning and increased cooperation between the state-funded universities in Bavaria.

c. **Outcome**: The Bavarian Virtual University, an innovative institution fostering university cooperation in providing online education.

d. **Key factors for success**: The success of the BVU has resulted from the following factors: the participation of all state-funded universities; the support of a stable government; the fact that the BVU is a state-independent, university-governed permanent organisation; and the long term perspective maintained by the BVU and its actors.

e. **Implementation challenges**: Challenges for the BVU include internet accessibility; lower interest on the part of certain disciplines; sustainability of the initiative (in the case of funding reduction or lack)

f. **Main changes**: The BVU has new types of cooperation and interactions among universities at many levels in the field of education, new methods of teaching delivery; more flexible learning.

g. **Results**: The Free State of Bavaria, compared with other Länder, occupies a leading position with regard to acceptance, distribution and integration of e-learning in higher education; cooperation helps to establish common quality standards for online teaching.

Part A: Setting the scene: introduction, challenges and contexts

A1: Introduction / definition of the innovation initiative

Overall objectives of the initiative and future plans

The aim of the BVU is, and has been from the start, to increase cooperation between the state funded universities in Bavaria on the issue of education. The use of e-learning should hence be seen in a broader context of generally increasing the quality of higher education courses in Bavaria, and increasing the accessibility of course programmes across university borders. The BVU promotes and coordinates the development and implementation of tailor-made online course offerings at Bavarian universities for students (for free) and others (low fee). In addition, the BVU allows universities to increase their experiences and competences in developing online courses.

With regard to the online courses, the concept used is "blended learning at macro level", meaning that the course (micro-level) needs to be completely online so that it can be used in the study programmes of all universities. However, the BVU does not provide a complete online study programme: study programmes (macro-level) are therefore blended, as parts are traditional face-to-face courses and others are online courses. It was never the intention to develop full online study programmes.

The objectives of the BVU over the course of time have remained valid, hence the BVU has remained fairly 'static' in relation to its objectives set. No major changes took place to rephrase the objectives set. On a state level, with the help of the BVU, Bavaria addresses several major issues:

- The growing overall demand for higher education, with growing student numbers at least until 2020.
- The urgent need to expand lifelong learning and to open the universities accordingly.
- Growing student diversity with growing demand for more flexible studies.
- The consequences of demographic change, leading to substantial population growth in some parts of the state while other regions face a serious decline. (The cooperation of universities in online teaching will help to maintain universities in regions of declining population).

In order to survive in a world of growing competition, universities need to cooperate not only in research, but also in teaching. The BVU is an excellent means of establishing and developing such cooperation. One of the positive effects of this cooperation is the establishing of common quality standards for online teaching.

The BVU avoids competition with its member universities. In particular, the BVU does not develop for-profit courses for further and continuing education. However, the courses are available to non-students for a low fee.

For the future of higher education, flexibility will play an ever more important role. Surveys show that already today the majority of the students are "non-traditional". The opening of universities for students with qualifications from work experience, the growing importance of lifelong learning and the increasing number of students in employment will strongly reinforce this trend. The online provision of the BVU works in line with this trend, allowing all current students to enrol in any course, and to allow non-students to participate for a low cost.

Future plans

The future plans of the BVU include a further increase in the number of courses and online offer within study programmes. This implies that more teaching content needs to be included in the online offer. The current coverage is large, in particular for economy, law, and medicine. Other departments need to be encouraged to develop their courses online and in cooperation with their peers.

Furthermore, there is increased attention towards developing/offering more online courses in English. In addition, the BVU is aiming to be used as an introduction programme for foreign students to acquaint them with Bavarian universities (e.g. the foreign students can learn about the LMU before arriving in Munich[14]).

Moreover, the online learning systems can be more student-friendly. To enrol in a course, students sometimes have to fill in two or three different passwords. The BVU wishes to establish a common authorisation-authentication system for all 30 member universities. At the moment this system has been established at nine member universities. In addition, as different Virtual Learning Management Systems are used (e.g. Moodle, Everlearn, Blackboard etc.), students are confronted with different systems in different courses. In addition, courses will have to become more modularly organised, so that elements of courses can be used in various occasions.

Finally, a challenge is to secure funding for the BVU. The current situation is good, but there are a number of challenges on the horizon which could put funding under pressure. One of these is the abolishment of student fees in Bavaria. This could cause universities to cancel the student dependent fee of one Euro per semester; however, the Ministry has guaranteed a full compensation for the abolished fees.

[14] Ludwig Maximilian University of Munich: www.uni-muenchen.de/

Outcomes of the practice

Output

The BVU is the Bavarian solution to a major common challenge for a better education for all against small public budgets. Since its foundation, the BVU has seen a steady development of both the number of courses developed and the number of students enrolled.

Figure 6: Student enrolment

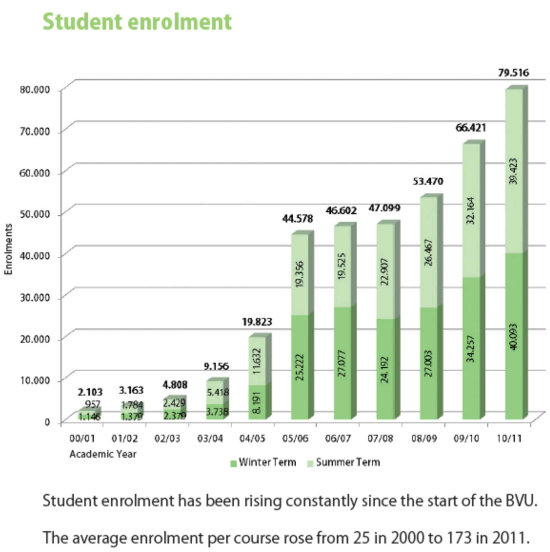
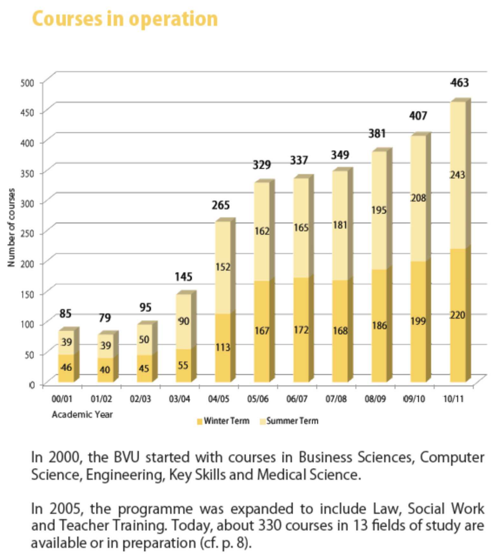


Figure 7: Courses in operation



Course enrolment across university borders is large: more than 55% of the enrolment is from a 'sending' university (e.g. year 2011/2012). The largest 'host' universities are:

Figure 8: 'Host' universities

University	Total enrolments	Home University
Uni Würzburg	38,212	17,168
Uni Erlangen-Nürnberg	17,922	7,543
Uni München	10,942	6,653

The largest 'sending' universities are: Uni Bayreuth (7,427), Uni Erlangen-Nürnberg (6,609) and Uni München (10,774). The students are mostly enrolled in courses delivered by the University of Würzburg, due to the law subjects being offered at the Universities of Applied Sciences.[15]

In May 2013 an external audit reported:[16]

[15] See annex for more details.

[16] Auditierung der Virtuellen Hochschule Bayern (vhb) Empfehlungen der Expertengruppe, München, 10. Mai 2013, p. 4. See: http://www.vhb.org/en/vhb/news-summary/newsdetails/artikelnr/156/. Translation: "According to the expert group, the BVU is judged to be a very effective and highly efficient operating institute, in particular with regard to their underlying performance of cooperating

"Sie ist nach Überzeugung der Expertin und der Experten heute eine sehr effektiv und hoch effizient operierende Einrichtung, die insbesondere im Hinblick auf die ihr zugrunde liegende Kooperationsleistung der bayerischen Hochschulen – über die Hochschultypen hinweg – auch in internationaler Perspektive Modellcharakter besitzt.Dass der Freistaat Bayern im Bundesvergleich im Hinblick auf Akzeptanz, Verbreitung und Integration von E-Learning an Hochschulen eine Spitzenposition einnimmt, ist deutlich auf die koordinierende, immer wieder impulsgebende Arbeit der vhb zurückzuführen. Im Zuge des enormen Aufwuchses der Studierendenzahlen in der letzten Zielvereinbarungsperiode hat die vhb zudem ihre Trägerhochschulen erfolgreich entlastet und sich als verlässlicher Partner erwiesen. Auch in Hinblick auf die Qualitätssicherung ist die vhb in allen Bereichen sehr gut ausgestellt. Ihre hohe Professionalität in diesem Bereich wird nicht zuletzt daran ablesbar, dass sie zur Beurteilung der bisherigen Leistungen und zur Vorbereitung der Zielvereinbarungen ein Expertengremium im Rahmen eines Audits hinzugezogen hat, dessen Arbeit in die vorliegenden Empfehlungen eingemündet ist."

In terms of positive benefits for the stakeholders involved, output can be described as follows:

Students

- More flexibility: no restrictions of time and place, students can schedule their individual study time.
- Greater choice of courses (and teachers).
- Stricter quality standards: students' assess each course each semester; each course is assessed externally by two non-Bavarian peers after five semesters.
- "E-literacy" added value: enhancement of their employability without any additional effort.
- Participation may be registered in the Diploma Supplement.

Teachers

- Financial support for the development and maintenance of courses (online tutors on the payroll of BVU; continuing training courses funded by BVU).
- Greater variety of pedagogical and didactical possibilities within the e-teaching and e-learning frameworks.
- Flexibility of teaching; wider range and numbers of students.
- Improvement of the face-to-face teaching on more advanced or specialised subjects (i.e. more time to devote to specialised courses).

Bavarian universities (crossing different types of universities) and possesses a role model function in an international perspective. The Free State of Bavaria compared with other Länder, occupies a leading position with regard to acceptance, distribution and integration of e-learning in higher education. This is clearly due to the coordinating, catalysing work of the BVU. In hindsight of the enormous growth in student numbers in the last period, successfully relieving the universities, the BVU has proven to be a reliable partner. Also in terms of quality assurance, the BVU performs very well […]."

- "Third-party-funding" in the performance record of the respective professors and faculties. Third-party funding is usually only for research. The BVU offers this funding for education.
- Many teachers appreciate the wider range of teaching they can have by contributing to the BVU's programme. They can focus on new ways of delivery.
- Organisation of regular workshops and seminars on e-teaching and e-learning; community building.
- Regular peer evaluation, introduced into German university teaching for the first time by the BVU; continuous improvement of the courses.

Universities

- Larger teaching offer.
- Additional teaching resources; reduction of logistic problems (lecture room shortages).
- Common quality standards (students assess BVU courses every semester; two non-Bavarian peers assess each course every five semesters).
- All BVU universities participate and contribute to the development of BVU courses. Decisions on programme development and funding are made through transparent procedures by elected representatives of the member universities.
- No control or restrictions on the adoption of a specific course management system. Various compatible systems are in use (like "Open Source" and "Moodle").

Society and the State

- Cost-effective organisation of online land-wide higher education across university borders.
- Avoidance of overlapping and repetition of courses or parts of them, costs reduction.
- The BVU draws upon the expertise and competence of the member universities and uses their infrastructures.

A2: Understanding of the context

The context in which the practice is developed (institutional, geopolitical, regulatory)

The ideas for the BVU emerged in a time when online learning was considered a disruptive innovation in Germany. In many Länder, initiatives were developed to start virtual universities. In Bavaria, the initiative was embedded (and financially supported) in the High-Tech-Offensive, aiming at modernising the economic and technological foundation of the state to make Bavaria one of the leading regions in technological development.

The initiative involved from the start all state funded universities and universities of applied sciences. In addition, a number of specific universities joined the BVU (such as the University of the Armed Forces).

Initially, there were different ideas amongst the universities on how to promote e-learning in Bavarian Universities, including distributing the funds across the universities equally. In the end the Ministry decided that the universities had to cooperate to make use of the funds and that a state-independent, university-governed body would be erected responsible for the distribution of funds meant for designing and delivering e-learning courses.

With regard to the contextual factors the following issues are essential to the existence of the BVU:

a. The joining institutions are all **state-funded** (Freistaat Bayern).

b. **Bavaria is politically stable**. The Christian Democrats (CSU – Christlich-Soziale Union in Bayern) have been in power since the World War II, creating a long-term perspective on matters. The lack of short-termism creates a fruitful atmosphere where new initiatives have the time to develop and grow. There is limited government interference. In addition, the opposition parties support the BVU.

c. The BVU is a **state-independent, university-governed permanent organisation**. A long-term perspective is inherent in the organisational structure as it does not depend on una tantum project-funding but on permanent funding from the state. The BVU is however governed by the universities themselves. The Office of the BVU is organisationally affiliated to the University of Bamberg.

Contextual factors that will impact the BVU (i.e. that will increase the importance of investing in online learning) are:

- The public budget will continue to be strained, in order to reduce the public debt and deficit.
- The number of students will rise considerably, at least until 2020. Later, demographic factors indicate a gradual decline. On the other hand, Germany and especially Bavaria wish to boost the proportion of their population with university-level education, and they wish to attract more students from abroad. This could also lead to growing numbers of students after 2020.
- In Germany higher education will continue to be basically state funded.

All these factors call for new ways of more effective and efficient education delivery. The BVU provides an answer for this.

A3: Challenges and identification of the specific drivers behind the innovation initiative

The challenges that the initiative aims to address

Bavaria was facing a number of macro-level challenges in the nineties. One of the most important was the foreseen increase in student numbers. This was caused by demographic developments and changes in the Gymnasium structure (finalized two years ago). In addition, the increase in students was desired by the government as well to maintain high education standards in the working population. Furthermore, there were (and still are) differences between the regions in Bavaria: in some regions, the population is increasing, whereas in others, the population is decreasing. This brings with it changes in the demand and supply of courses of universities. The foreseen and desired increase of students and the changes in the level of services cause universities to make changes in the way they provide education. Through the online offer and the cooperation between universities, the offer can become more efficient (serving more students) and the services can be provided in regions where the level of service is decreasing. Hence, the initiative is not only about promoting e-learning to address challenges, but the demand for cooperation is an essential element in overcoming the challenges identified.

The immediate cause for developing the initiative

The immediate cause/opportunity for establishing the BVU was the funding initiative High-Tech-Offensive. Through this funding initiative universities received money to increase their efforts in e-learning. The BVU was established to distribute these funds.

Part B: The higher education innovation system: functions, components and relationships

B1: Analysis of the functions

The function to which the innovation is related

The function the BVU is related to is primarily the course development and delivery. In addition, the BVU impacts the way the courses are quality assured. The courses of the BVU are developed at the individual member universities; there is no central production unit within the BVU. Generally, within the universities (or within their institutes which provide online education) there is a clear division of labour. Content is usually provided by professors, who then employ skilled staff for the transformation of that content into an online course. In some cases (mostly at universities of applied sciences), professors also take part in the technical implementation.

Course development

Although courses are developed at individual universities and differ between them, they are developed within a consortium. The allocation of funds for developing a course consists of two main steps: first, a call for proposals, and then a call for tender.

- In the call for proposals, member universities are invited to submit proposals for new online courses. For each course the interested universities form a consortium with a consortium leader. Proposals by only one university are not eligible. There must be a demand for the given course by at least two member universities, and the online course, once it is completed, must replace part of the face-to-face teaching at the universities of the consortium, so that an actual relief of the teaching load in the given subject will be accomplished at these universities.
- In the call for tender any consortium can respond to the identified need for a course (identified in the call for proposals). The course should in the end meet the expectation of all consortium members.

From initial idea to course delivery, it can take 1.5 years. When a proposal is accepted (i.e. when the course is felt needed), this does not automatically mean that the consortium will win the tender. It can be the case that another university answers the call for tender and develops the course.

Course delivery

The developed courses make use of all kinds of didactical tools found in online provision.

Quality assurance[17]

For the BVU course, several quality assurance arrangements have been established. First of all, the courses are evaluated after each semester. In addition to this, every five semesters, two external (non-Bavarian) experts assess the quality of the course (whether it is up-to-date, whether the content meets scientific demands, if the course is well structured). The feedback from these experts is used to improve the course and it can even lead to discontinuing the course delivery.

The quality assurance takes place at different stages and levels:

1. Conceptualisation of the online course: Staged application procedure, where the steering committee can assess whether the courses are needed and who (finally) will be responsible for the course development and delivery.
2. Development of the online course: Assistance with the project management (BVU), education and training of the staff (e-tutors).

[17] See: Virtuelle hochschule bayern, Qualitätsmanagement der Virtuellen Hochschule Bayern (Stand: 31.10.2012)

3. Implementation of the course:
    a. Student evaluation (although it is mentioned that as with traditional student evaluations, the feedback is rather superficial).
    b. External expert evaluation.
    c. Monitoring by the project manager (BVU)
4. External evaluation of the BVU (in 2005).
5. External audit of the BVU (2013).
6. Yearly reporting of the BVU.

German laws on data protection constrain universities to use online user data to improve the courses. The development of common quality standards for online courses is considered a breakthrough as well, as it facilitates mutual trust in each other's courses. For the maintenance and adjustment of the course, additional funds are available.

Impact of the innovation on other functions

The BVU has impact on the general attitude towards e-learning. Universities feel the need to establish their own central facilities to support e-learning, they have their own Moodle-servers and support structures for professors willing to offer online courses. In addition to this, in smaller universities, there is a call for more (technical) support in online course development by the BVU. Currently discussions take place whether the BVU should increase its efforts in this direction (or whether it should focus solely on project management).

Also, the BVU allows universities to 'look over the fence' and learn from other state-funded universities on how they organise their course development and delivery.

The BVU project funds are the only third-party funds available for teachers to use for education. Normally, third-party funds are allocated for research purposes. The extra funds enable staff to focus on improving their courses. The broader impact of this is that staff focusing on education instead of research feel better rewarded and acknowledged as they feel that education is as much a priority in their work as doing research.

B2: Analysis of the components

The organisational model implements the cooperative model between HEIs in Bavaria, both universities and universities of applied sciences. The governance is based on democratic principles in which all institutions have their say.

Financing

Between 2000 and 2011 a total of 35.3 million Euros was spent on the BVU and its courses, including student tuition fees. In part this financing came from the ordinary Bavarian state budget, in part from special programmes of the Free State of Bavaria and from German Federal resources. The member universities contribute one Euro per student and semester, i.e. a total of around half a million Euros per year. With the special programmes being finalised next year, the Bavarian Ministry will have to increase its state funding. This is currently under discussion in Parliament. Given the positive attitude towards the BVU, it is unlikely that the Ministry will not find a solution (NB: it is felt that the money is for the universities and that the BVU facilitates in the right way the distribution of these funds to the universities).

Implementation of the initiative

Though initiated by the Ministry, the organisation, development and implementation of the initiative were carried out in close cooperation and mutual ownership of all the state-funded universities. It is important to note that both the universities and universities of applied sciences are involved on an equal footing in the initiative.

Table 9: Actors/stakeholders, level of operation, roles and responsibilities and activities

Actor	Level (macro, meso, micro)	Role/responsibility	Activity
Ministry	Macro (state level)	Initiator	Provides funding and legitimacy
30 Member Universities	Meso (university/institute level)	Governance; beneficiary	Appoints (vice) president; elects delegates; responsible for the programme committee and steering committee; governs the BVU; provides funding per student/semester; receives project funding for course development/delivery
BVU (Director and Office)	Meso (university/institute level)	Operation of the BVU; project management	Secretariat of the BVU, project management; organising calls, student support
University staff (teachers, tutors, IT support etc.)	Micro (staff/student level)	Developing and delivering courses and examinations, and providing tutoring	Write joint proposals, develop courses, deliver courses, responsible for examination, tutoring

Students	Micro (staff/student level)	Enrolled in the online courses	Studying
External experts in the course evaluation	Micro (staff/student level)	Quality assessment	Review the courses after five semesters

B3: Analysis of the relationships

The nature of the relationship

As mentioned, the funds provided by the Ministry are aimed at increasing the online offer within the universities. In this the BVU, as a university-owned platform, is responsible for distributing these funds in the best way to the individual universities. As the funds are for the benefit of the universities, through this construction (i.e. joint responsibility of funds distribution), it is generally felt that it is indeed the case that the funds are distributed in the best way possible. The BVU organisation is independent, but governed by the universities. Staff of the universities (teachers, tutors and IT support staff) can apply for funding to develop and deliver online courses. Students can / have to enrol in the courses.

Changes in existing relationships

The main innovative feature of the initiative regards the interaction among universities on education. Where cooperation in the domain of research is common practice, in the domain of education, cooperation between universities is less common (or to put it more strongly: absent). The development and delivery of BVU courses calls for close cooperation and course delivery across university borders and even between universities and universities of applied sciences.

The relationship between teacher and student has changed as well, although not as radically as it is sometimes suggested when education changes from traditional face-to-face to online mode. Direct communication between professors and (large groups of) students is minimal in both the traditional setting and online provision. On the other hand the BVU provides the opportunity to hire e-tutors who can assist students, comment on their work and help them on an individual basis.

A new relationship has been established which implies cooperation among peers (experts) from outside Bavaria, who are asked to provide feedback on the online courses. This peer review system is highly developed in the research domain, but absent in the education domain.

Impact of the relationships on the innovative practice

The following table provides an overview of the relationships and what has changed due to the initiative.

Table 10: Relationships between actors

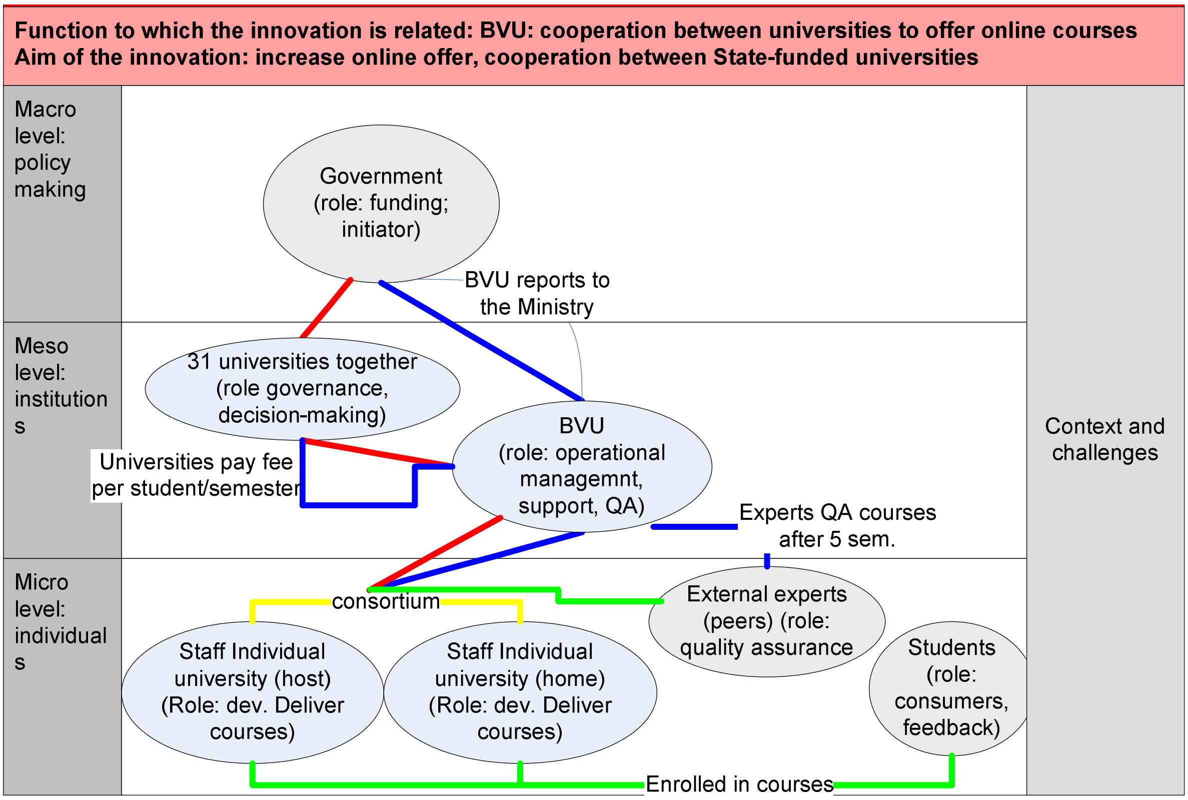
Actor 1	Actor 2	Relationship	What changed?
State	Universities	Funding	Specific funds allocated to e-learning
Universities	Universities	In education issues absent Governing the BVU	Cooperation in developing and delivering e-learning
Teachers (staff/professors)	Students	Teaching-learning	Distance relationship increased opportunities for individual tutoring
Teachers (staff/professors)	Universities	Researchers/educators	Acknowledgement for teaching, receiving additional funds for course development

B4: Cross-elements analysis

Drafting an innovation system map

The figure below provides a concise characterisation of the innovation system map related to the BVU.

Figure 9: Higher education innovation system for the case of BVU



Key:

	Blue	Funding (role)
	Red	Driving (role)
	Yellow	Collaboration/conflict (relationship)
	Green	Service/consumer (relationship)

Conclusions related to the innovation system map

What can be seen is that the BVU organisation is merely a facilitating organisation.

The approach can be characterised as top-down, as the Ministry intended this structure to stimulate universities to cooperate in the development of e-learning courses. On the other hand, from an organisational and course development perspective, the approach is bottom-up, as neither the Ministry, nor the BVU determines which courses need to be developed and how. This depends on the input from the consortia of universities.

Concerning the lines of authority, the governance is rather democratic. The universities (universities and universities of applied sciences) are involved in the governance of the BVU, they are responsible for the organisation and to some extent have ownership over the BVU. The Ministry does not play an influencing role in the daily operations of the BVU.

Within the universities the BVU and the staff involved in online course development and delivery impact the general attitude towards e-learning. The larger universities have their own IT support staff, involved in other types of e-learning as well (MOOCs, PodCast, own e-learning courses); in other, smaller universities there is growing demand for expertise and support to develop online courses.

The role of students is rather traditional: they benefit from the online courses as they are more flexible and the presence of a tutor enhances their engagement. Students are asked to provide feedback after the course.

Barriers and bottlenecks

Initially, discussions arose concerning the structure of the BVU and where the BVU would be positioned (for a short time the BVU was based on two locations: Bamberg and Hof). Particular barriers and bottlenecks for the BVU are the following:

- The BVU courses can be found mostly in specific departments (medicine, law, economics) and less in departments such as humanities or natural sciences. As there is not a strong top-down steer, the course development in these areas lags behind.
- Internet accessibility for some students is still a barrier. Especially when courses include large data files (video seminars), the internet connections can be too slow.
- The courses are developed by different universities, each using their own virtual learning environment. This means that students sometimes have two or three different user-names and password combinations to access their courses. Currently, the BVU works on aligning entry procedures by creating universal user-names and passwords. This however requires that the student administrations of all the universities are harmonised and linked, which appears to be quite a challenge.
- The future financial situation is unclear, but there is no doubt that for the next few years sufficient budget will be allocated to allow the BVU to further develop.

Quoting a student's view on the BVU courses, it appears that the flexibility is valued. However personal contact is lacking, making the online courses are somewhat impersonal and to some degree anonymous.[18]

[18] Statement provided by a student. "Die Flexiblen Zeiten eines VHB-Kurses sind vorallem für einen Lehramtsstudenten wie mich sehr gut. Es ist gut, dass man den Kurs bearbeiten kann wann man will, und nicht zu einem bestimmten Zeitpunkt in einem Hörsaal sein muss. Schade ist jedoch bei den Tutoren eines VHB-Kurses, dass das persönliche Gespräch fehlt. Die online-Kurse sind etwas unpersönlich und bis zu einem gewissen grad anonym." Translation: "The flexible hours of BVU course are especially very good for a teacher-student like me. It is good that you can work on the course when you want and not have to be in a lecture hall at a certain time. Too bad, however, is that the personal contact with the tutor of BVU course is missing. The online courses are somewhat impersonal and, to some degree anonymous."

Influence of the context on the success of the initiative

A contextual factor that impacts on the development and the operation of the BVU is probably the stable political climate in Bavaria and the broad support for the BVU (amongst parties in government and the opposition). This involves a long-term perspective on the BVU instead on quick results and short-termism.

In addition, the universities lean heavily on state budgets in Germany. This means that the state (Free State of Bavaria) can determine to some extent what general services universities need to provide against what costs. Competition exists, but this creates room for cooperation as well.

Demographic developments (and related), such as rising student numbers, maintaining service levels in areas of population decreases, et, provides arguments to stimulate the further development of online course development in a cooperative way.

Outcomes and results

The BVU grew steadily over the years and became a stable and trustworthy organisation, both supported by the government and the member universities. The recent (May 2013) external Audit emphasised the quality of operations.

Transferability

To understand under which conditions this innovative model can be transferred to other contexts, first we need to see on which (contextual) factors the success of the BVU depends:

a. The concept of **macro-level blended learning and asynchronous ways of communication**, allowing students to blend online courses and face-to-face courses to obtain a qualification.

b. The idea that universities need to **cooperate** in developing and delivering courses.

c. All participating universities are **state funded institutions**.

d. There is a stable government in Bavaria with a **long term perspective** on e-learning. Hence, there is no pressure for immediate success and initiatives have time to develop and mature.

e. The BVU is an organisation jointly governed by the universities. There is **joint ownership** and there is no sentiment that the BVU 'takes away funds initially intended for universities'; on the contrary, the BVU provides opportunities for the existing universities to make use of its funds.

From a governance perspective, the BVU initiative has been considered a very realistic initiative from the start. It is not driven by a visionary perspective, but by how e-learning can contribute to make university-level education better, more effective and efficient. Although the BVU is a successful initiative, it should confine itself to maintaining its role as 'broker' and not taking up a larger role. If the BVU takes up a larger role (e.g. developing courses, giving more steering on particular subjects, creating its own virtual learning environment) this could in the end conflict with the ambitions of the member universities, undermining its support.

The BVU has been in operation for 12 years and the results are impressive. On the other hand, it appears that attention to the BVU is not increasing and that it is currently a well-established practice. A renewed impetus would be desirable to further enhance the benefits of the BVU for Bavarian students, universities and society.

Based on this, it can be concluded that the model is transferable under the following conditions:

1. The universities are governed centrally (i.e. are state funded);
2. Universities need to be willing to cooperate (receiving funding for that purpose will obviously help) and need to be in control of the funds available. Any top-down decision-making running counter to the autonomy of the institutions hampers the willingness to cooperate.
3. The initiative needs to take a long-term perspective: not intending to change the HE sector overnight, but to gradually innovate the sector. This should be reflected in the structure of the organisation managing the funds: this should have a permanent status, not be based on project funding only.

Part D: Annexes

D1: List of literature used

Auditierung der Virtuellen Hochschule Bayern (vhb) 2013. Empfehlungen der Expertengruppe München, 10. Mai 2013.

Bericht der Gutachtungskommission zur Evaluation der Virtuellen Hochschule Bayern (vhb), 2. März 2005

Bremer, Claudia, Göcks, Marc, Rühl, Paul, Stratmann, Jörg 2010. Landerinitiativen für E-Learning an deutschen Hochschulen.

Bavarian Virtual University. The Network for Higher Education Online in Bavaria (leaflet)

Virtuelle hochschule bayern Personen Stand: Dezember 2012 (leaflet)

Virtuelle hochschule bayern in Zahlen Studienjahr 2011/2012 (leaflet)

Virtuelle hochschule bayern 2012. Qualitätsmanagement der Virtuellen Hochschule Bayern, Stand: 31.10.2012.

Virtuelle Hochschule Bayern 2012. Newsletter Nr. 4/2012 Datum: 20.12.2012. [online] Available at: http://www.vhb.org/startseite/. [Accessed: 7 July 2013].

D2: List of contributors to the case study

Name	Organisation	Country
Paul Rühl	Managing director BVU (VHB)	Germany
Prof. Ulrich Pohl	Vice President, Munich University LMU and Chairman of the BVU's Programme Committee	Germany
Armin Rubner	IT manager LMU	Germany
Ralph Berg	Ministerialrat (Bayerisches Staatsministerium für Wissenschaft, Forschung und Kunst - Bavarian Ministry for Higher Education	Germany
Georg Seppmann	BVU project manager	Germany
Prof. Dr. Inge Scherer	Universität Würzburg Juristische Fakultät	Germany
Prof. Dr. Hans-Georg Weigand	Universität Würzburg Lehrstuhl für Didaktik der Mathematik	Germany
Silke Prechter	Student "ABC - Grundlagen der Analysis"	Germany
Johannes Kröckel	Dipl.-Wirtsch.Inf. Wirtschaftsinformatik II Universität Erlangen-Nürnberg	Germany

Methodological note

The consultant had numerous contacts with the Managing Director of the BVU. From May 22 to May 25 2013, the consultant visited Munich and organised face-to-face interviews with Paul Rühl, Prof. Ulrich Pohl, Armin Rubner, and Ralph Berg. Also, the consultant visited the office of the BVU in Bamberg and spoke extensively with Georg Seppmann and with the present personnel (five people). In addition, two staff members were interviewed by phone (Prof. Dr. Inge Scherer; Johannes Kröckel). Finally, Prof. Dr. Hans-Georg Weigand and student Silke Prechter preferred to provide their perspective in writing.

In addition to the interviews and the necessary document analysis, the consultant received access to one (selected) BVU course (Introduction to Ethnology) to test the online learning environment.

D3: Additional annexes to the case

Introduction

The Bavarian Virtual University (BVU)[19] is an institute set up in 2000 by the nine universities and the 17 universities of applied sciences of the Free State of Bavaria, one of the 16 German Länder. Like its member universities, the BVU is financed by the Bavarian Ministry for Higher

[19] The English abbreviation BVU is used in this case study report. The official (German) name is Virtuelle Hochschule Bayern.

Education, Science, Research and the Arts (Bayerisches Staatsministerium für Wissenschaft, Forschung und Kunst).

The BVU facilitates online courses with an equivalent of two to six (ECTS[20]) credit points which the member universities can integrate into their courses of study. The BVU supports member universities to develop courses in cooperation with other member universities. Almost all of our 31 member universities import BVU courses into their courses of study, and the majority of the universities are active course providers as well. The BVU funds the operation of its courses as well as their production. By financing tutors according to the demand for its courses at the member universities, the BVU facilitates the utilisation of the courses across university borders: supported by online tutors, dedicated teachers can reach students at all interested universities.

To facilitate the exchange of courses among the member universities, the BVU focuses on blended learning at the macro level of the study programme.[21] The courses work completely online, so that the only effort required of the "importing" university is to provide rooms and supervisors for the final examinations. The BVU is not a distance teaching university, but with the help of the BVU all Bavarian universities integrate the distance mode into their programmes, thus making the programmes more flexible. Through the courses developed and delivered via the BVU, students earn credit points. The BVU offers neither complete programmes nor degrees.

Start-up phase

Distance learning initiatives were developed in Germany for many decades. Around 1998, due to the emergence of the internet, e-learning became a buzz-word in the university world. It was suggested that online learning would change the higher education landscape radically.[22] In

[20] European Credit Transfer System

[21] See http://www.vhb.org/fileadmin/download/Bavarian_Virtual_University.pdf on the concept of macro-level blended learning: "Blended learning" is often interpreted as the combination of face-to-face teaching and web-based teaching within a single course. We call this type of blended learning "micro-level blended learning". While micro-level blended learning has many pedagogical benefits, it does not make full use of the economic possibilities of e-learning. If the web-based elements are developed and exploited by only one professor at only one university, micro-level blended learning seems to offer higher quality or added value only at additional costs. Teachers who use single e-learning elements in their courses do not necessarily gain additional teaching time, and micro-level blended learning is hardly a remedy e.g. against the shortage of lecture rooms many universities face. For the students, micro-level blended learning offers rather limited flexibility. The more face-to-face elements there are in a study programme, the more difficult it is to adapt to the needs of non-traditional students. By contrast, the BVU focuses on macro-level blended learning with the aim of offering high-quality teaching with intensive tuition in a cost-effective way. By macro-level blended learning we understand the integration of online courses into study programmes which otherwise (and for the most part) consist of "traditional" face-to-face courses (seminars, lectures etcetera). Thus, students can learn some credits in online courses, but not their complete degree. This combination of face-to-face courses with courses which are delivered completely online (possibly with the final examination being held face to face) allows the students much more flexibility than micro-level blended learning. At the same time the students enjoy all the benefits of a traditional face-to-face university. Therefore, macro-level blended learning minimises the dangers of social isolation sometimes associated with e-learning. Moreover, if online courses are developed at one university, but used at several universities, the comparative cost effectiveness is obvious. Thanks to macro-level blended learning, universities can "import" courses from other universities, including the support of their students by tutors from the "exporting" university. In contrast to micro-level blended learning, this kind of import also helps universities to compensate for a possible lack of teachers as well as room shortages.

[22] For instance the Bertelsmann Stiftung published a study in 2000, stating that in 2005 50% of the students would study only in an online environment: Encarnacau, Jose; Leithold, Wolfgang; Reuter, Andreas (2000), Szenario: Die Universität im Jahre 2005, in: Informatik Spektrum 23 August 2000, P. 264- 270.

addition to this, in Bavaria the 'High-Tech Offensive Bavaria'[23] was launched in 1999. The objective of this initiative was modernising the economic and technological foundation of the state to make Bavaria one of the leading regions in technological development. Within this setting, funds were available to modernise the university level education (+/- 22 million Euros).

The Bavarian Ministry for Higher Education, Science, Research and the Arts decided that these funds would not be distributed to individual universities, but that universities[24] needed to cooperate in improving education to receive the funds. In addition, it was decided that the money will not be distributed as some kind of project funding (with the implication that it has a pre-determined duration), but that structures needed to be established that would endure after the funds are finished. As a consequence of these two reasons, it was decided that the funds will be distributed through an organisation which is independent from the Ministry and which is governed by all Bavarian State universities. In this sense, the initiative depends on a top-down approach (the Ministry decided to organise it this way) and a bottom-up approach (decision making within the organisation is in the hands of the universities).

The fact that universities need to cooperate with regard to education is considered innovative and is one of the key factors of the BVU. In other German Länder, the 'virtual universities" did not deliver what was intended partly as a result of a different structure chosen (e.g. a separate institution to develop and deliver the courses besides the regular universities). The Bavarian model builds on ownership, trust, reputation of the member universities and cooperation between universities.

This close cooperation is not in conflict with the ever more important idea of competition among universities. Competition should be for ideas and best solutions, but in a state-financed public university system competition at the taxpayer's expense should be avoided. No single university can be best in all its subjects, and the creation of high-quality online courses is so expensive that nobody would profit if we tried to reinvent the wheel three times over in different places.[25]

The process of choosing new courses for the programme of the BVU consists of two main steps: first, a call for proposals, and then a call for tender. In short, the process is organised as follows:

- **Call for proposals:** Twice a year, member universities are invited to submit proposals for new online courses. For each course the interested universities form a consortium with a consortium leader. Proposals by only one university are not eligible, with the rare exception of cases where a subject is taught at just one

[23] See: http://www.bayern.de/High-Tech-Offensive-.1380.htm
[24] With 'universities', if stated otherwise, both universities and universities of applied sciences are covered.
[25] See: http://www.vhb.org/fileadmin/download/Bavarian_Virtual_University.pdf , p. 2.

Bavarian university.[26] The proposals are submitted in a standardised form. There must be a demand for the given course at least at two member universities, and the online course, once it is completed, **must replace part of the face-to-face teaching at the universities of the consortium, so that an actual relief of the teaching load in the given subject will be accomplished** at these universities. The consortium must define the curriculum or curricula (courses of study) in which the new online course will be employed, and they must give an estimate of the number of students they expect to participate per academic year. The consortia and their courses do not function as "closed shops". All member universities are entitled to employ the courses, and students of all member universities can attend the courses free of charge, no matter whether their university is a member of the given consortium or not. Students from universities outside a consortium are advised to make sure whether their home university will acknowledge credit points earned in such courses before they enrol. The proposals are examined by the BVU's Programme Committee. The Programme Committee selects the proposals most suitable for funding and passes its recommendations to the Steering Committee. The Programme Committee does not necessarily favour the proposals with the highest demand, i.e. with the largest number of expected participants. Special attention is paid to proposals for courses which make possible the establishing of new curricula at member universities, e.g. Masters programmes at universities of applied sciences. On the basis of the recommendations of the Programme Committee, the Steering Committee decides which proposals to fund. The consortia supporting those proposals are then invited to submit detailed descriptions of the courses.

- **Call for tender:** These descriptions are the basis for the next step of the process, the call for tender. Generally (but not necessarily) bidders make a bid both for the production of the course and for the tutorial guidance of the students. The production of standard courses with an equivalent of two hours per week and semester (mostly 3 ECTS credit points) can be funded with up to 40,000 Euros. Costs exceeding this sum must be born by the consortium. Up to now, there have hardly been any such instances. For the majority of proposals one bid is submitted by a member of the given consortium, but there are instances where competing bids are made. There are also instances where the only bid comes from a university outside of Bavaria. The producers of the course further commit themselves to arrange personally for the operation of the course (i.e. to provide tutorial services

[26] E.g. veterinary medicine. Proposals for such subjects are eligible if they are submitted in cooperation with a university outside of Bavaria.

and guidance) for at least five years. Should the producer not be in the position to operate the course any more, the BVU can transfer the operation to somebody else. Up to now there have been few instances where a transfer of course operation has been necessary. In most of these cases the course operation was taken over by another professor of the producer's university. All members of a given consortium have the right to take part in the quality assurance process during the production of the course. They are encouraged to do so, especially by taking part in milestone meetings where the state of the work in progress is presented and discussed. Members of the BVU project management take part in these meetings. Thus, all members of a consortium can make sure that the final course will meet their expectations; problems can be solved at the earliest possible stage.

From initial idea to course delivery, it can take 1.5 years. When a proposal is accepted (i.e. when the course is felt needed), this does not automatically mean that the consortium will win the tender. It can be the case that another university answers the call for tender and develops the course.

Course delivery

Owing to the large variety of fields of study with their different traditions, there is a corresponding variety of pedagogical approaches in the BVU's courses, including virtual seminars with intensive student cooperation, online lectures with tutorials and virtual laboratories. In many courses students deliver papers. Self-study environments play a minor role, however they exist especially in the field of medicine (as preparation for practice). The courses are developed by the individual universities in consortium with others. This entails that the courses can be very different and can make use of different virtual learning environments (Moodle, Everlearn, Blackboard etc.).

A key element in the course delivery is the asynchronous form of communication. This means that the course as such should be independent from the time of delivery so that students can truly study whenever they like. An essential element however, is the tutoring. Each course includes a tutoring element. This means that staff is available to assist students in going through the course. The work of the tutors includes giving individual assistance on course-related issues, correcting papers/essays and providing feedback.

The tutors are training at the expense of the BVU to become e-tutors. This training course, naturally in the form of an online seminar, allows participants to acquire knowledge of the various learning and teaching theories and of online learning methodology. The principles of the basic technology are also taught.

The online courses are integrated in broader courses in the individual universities. Therefore it can be the case that different numbers of credits are awarded in one university compared to another, where the same course is used; this is due to additional study activities being included in the broader course.

Examination

The examination can be organised differently per course and university. The examination can be organised traditionally, where the students need to be present in a room to take the examination at the institution delivering the course. On the other hand, the examination can also take place at another university when the university provides facilities to do so (local examinations). Finally, some exams are taken online, not requiring personal attendance.

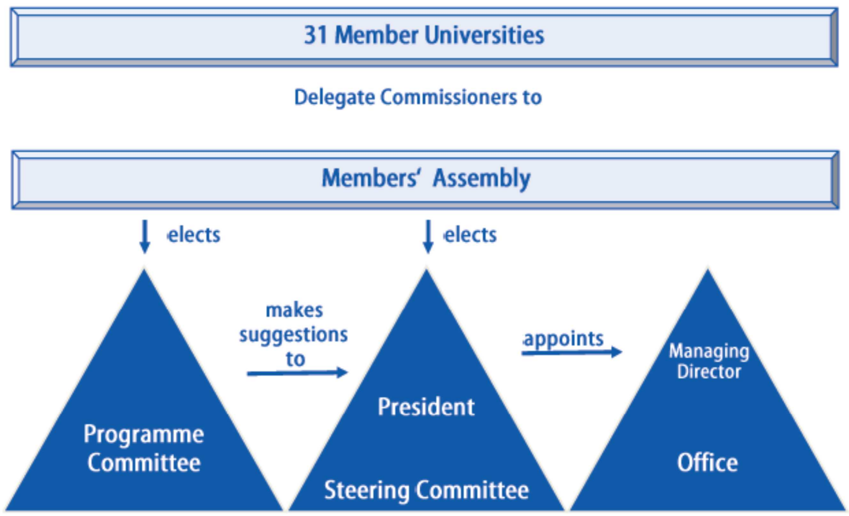
As the courses can be followed by both students and non-students (who pay a fee), it is not always necessary that the participants will (want to) conduct the exam. In fact, 60 per cent (in 2010-11) of the enrolled students participated in the examination. This does not mean that 40 per cent is considered drop-out. A large proportion of these students enrol in the course to refresh their knowledge on a particular issue, to prepare for exams in their home university, or prepare for a state examination (e.g. in law subjects).

When the course is not part of the regular programme, students are advised to approach the course provider before course registration.

Introduction organisation

The figure below provides an overview of the governance structure of the BVU.

Figure 10: Governance structure of BVU



The **Members' Assembly** is the BVU's basic body. Each member university is represented by a Commissioner, who in turn is the key person for all BVU affairs at his or her home university.

Each university has one vote per 5,000 students. The Members' Assembly elects the **Programme Committee** as well as the **Steering Committee** and makes basic organisational decisions. The Steering Committee consists of the **President and two Vice Presidents**. The President of the BVU is president of a university, and one of the Vice Presidents is President of a university of applied sciences. This ensures smooth coordination with the respective Conferences of Presidents and Rectors. The Steering Committee makes budget decisions and appoints the **Managing Director**. The Programme Committee consists of eight people. Five of these must be Vice Presidents, preferably for questions of teaching and studying at their respective universities, and one must come from a university outside of Bavaria. The Programme Committee makes suggestions to the Steering Committee in all matters of programme development and quality management. As Head of the **Office**, the Managing Director runs the day-today business of the BVU. In the Office, 16 employees work in the areas of finances, project management, public relations, student registration and technical support.

Other important stakeholders are of course:

- The **Bavarian Ministry for Higher Education, Science, Research and the Arts** (Bayerisches Staatsministerium für Wissenschaft, Forschung und Kunst).
- The **staff from the universities** (teachers, tutors, course developers, IT-support staff).
- **Students** enrolled in the courses.
- **External experts** in the course evaluation (after five semesters).

The e-Advisor at Arizona State University (US)

Author: Dr Marina Ranga

Overview

a. **Driver:** The e-Advisor, ASU's electronic advising and degree tracking system, was driven by the need to educate ever increasing masses of students, providing high quality education and producing more college degrees at more affordable costs. As such, the initiative addresses the changing supply of and demand for higher education.

b. **Strategy:** Use of modern technology and data analytics to help students select majors that best fit their interests, stay on track and thus ensure successful graduation. The e-Advisor is part of a broader set of innovations at ASU (e.g. online courses, adaptive learning and shorter courses), which the university has adopted in its strategic move from a "school-centred" to a "student-centred" and "customized education" approach.

c. **Outcome:** The e-Advisor has a high potential to increase retention and graduation rates, improve the learning process and students' academic performance, give students more freedom and choice in the learning process, better understand their individual needs and circumstances, and ultimately increase the quality of their education and their employability success.

d. **Key factors for success:** ASU's innovative environment and education vision, the dedication of the institutional team in charge of the development and implementation of the e-Advisor.

e. **Implementation Challenges:** Low awareness of potential students of academic life and requirements, low retention and graduation rates, technical complexity of the system.

f. **Main changes:** The e-Advisor has introduced a triple range of changes: to students in improving the capacity to choose a major, stay on track and identify solutions in case of going off track, to academic advisors in better understanding students' profile, needs and engagement, and to the university, in the more effective management of enrolments, saving money while improving student success.

g. **Results:** Increase of student retention and graduation rate, and important cost savings to the university. An 8% improvement in the student retention rate, from 76% to 84% since its start in 2008-9. Approx. 720 additional students a year advance from freshman to sophomore year. Each percentage point increase in the retention rate generates approx. $1.7 million in recurring increased revenues for ASU, while greatly increasing the likelihood that those retained students will graduate. The four-year graduation rate increased from 32% for the fall 2005 cohort (before the e-Advisor) to 42% for the most recent cohort (fall 2008). Important cost savings for the university also arise from lower instruction costs due to enhanced retention and graduation rates (approx. \$6.5-\$6.9 million in instruction costs, more than \$1 million saved due to the math adaptive learning courses, approx. \$9 million in gross tuition revenue gains).

Part A: Setting the scene: introduction, challenges and contexts

A1: Introduction / definition of the innovation initiative

Overall objectives of the initiative and future plans

The e-Advisor is ASU's electronic advising and degree tracking system. It uses modern technology and data analytics to help students find majors that best fit their interests and thus ensure they have the highest likelihood of graduating. The comprehensive e-Advisor system implemented at ASU builds on a prototype developed at the University of Florida in 1996 by Prof. Elizabeth Phillips, then Provost at the University of Florida, now Executive Vice-President and Provost at ASU.

The key objectives of the initiative are to increase the student retention and graduation rate and provide quality education at affordable costs to an ever increasing number of students.

The e-Advisor has introduced a triple range of changes:

a. **To students**: Help in the choice of a major, in staying on track and in identifying solutions in case of going off track. ASU currently provides about 290 majors and most programmes admit majors in the junior year. Choosing a major where the student has the highest chances to succeed could be a daunting task. Prior to the introduction of the e-Advisor, students used their freshman (1st year) and sophomore (2nd year) time either searching for a major or enrolled in a pre-major sequence (e.g. pre-business, pre-architecture) in which they acquired the credentials required for admission to the major of their choice. However, it was not until the end of the sophomore year that students knew if their grades were high enough to ensure admission to the major. In case of failure, they had to seek another major with possibly different requirements, re-enter an exploratory mode or transfer to another institution. The e-Advisor facilitates the choice of a major, by providing a wide range of curricular alternatives, helping students understand degree requirements, keeping them on track for progressing toward a degree with every class they take and showing them if they start to go off track. If a student needs to change majors, the e-Advisor shows them how the courses taken will fulfill the new degree requirements (Phillips, 2013). The system also uses data mining techniques to analyse student success patterns and predict success in each major, matching the student performance with the anticipated success patterns. The success of the e-Advisor in keeping students on track to graduation is so important that it has now been placed also in local community colleges, helping ease transfers to ASU and avoid any waste of credits already acquired by the students.

b. **To academic advisors**: It makes academic advisors more informed, efficient and effective. Students who fail to get pass grades meet with an advisor and have a realistic and thoughtful conversation aimed to put them back on track, or change the major, if the student has failed twice. Advisors and students can quickly review many degree alternatives to identify those that meet the student goals with the least investment of time and money in additional requirements. Prior to the e-Advisor, this review was based on looking up for degree requirements in catalogues, paper scheduling sheets and review transcripts, all of which was very time-consuming and error-prone. The e-Advisor eliminates this work and allows the advisor and the student to focus on criteria for success. The student information provided by the e-Advisor helps the academic advisors get a better understanding of students' personal goals and needs, career/graduate school options, transfer or credits, time/stress management, campus life and involvement. ASU currently operates with 350 students per advisor on average. The e-Advisor also allows monitoring the work of the academic advisors and improving both the efficiency of the system and advisor consistency.

c. **To the university**: It helps the university to manage enrolments effectively, saving money while improving student success. The e-Advisor provides complete information on every student's major, courses completed and courses needed, so that it is possible to know in advance which courses are necessary in the next semester for all students, how many of the curses are critical, how many seats are needed in every critical course and how to ensure they are guaranteed, how many instructors are needed, etc., enabling students to progress. This increased precision in the allocation of university facilities, combined with increased quality of academic advising and monitoring of student performance has led to successful outcomes.

Outcomes of the practice

At the University of Florida, the e-Advisor resulted in a 20% increase in the graduation rate. At ASU, the system has started to be implemented in the academic year 2008-9 and it has already resulted in an 8% improvement in the student retention rate, from 76% to 84%. With a first-year class of approximately 9,000 students, this increase is translated into an additional 720 students a year advancing from freshman to sophomore year, who otherwise might have dropped out (ASU News, 2011). Each percentage point increase in the retention rate generates approximately $1.7 million in recurring increased revenues for ASU, while greatly increasing the likelihood that those retained students will graduate (Phillips, 2013). The four-year graduation rate increased from 32% for the fall 2005 cohort (before the e-Advisor) to 42% for the most recent cohort (fall 2008) (Philips, 2013). After the introduction of the e-Advisor, students are much more on track and the quality of the academic advising has improved, with the academic advisors having better knowledge about the reasons for students going off track.

Funding of the initiative

The funding for the e-Advisor comes both from public sources (the university) and private ones. The initial university investment of about $625,000 annually over the first four years of implementation has been complemented with private investment of $1 million from the Kresky Foundation for the development of the e-Advisor transfer partnership component (which allows the transfer to ASU of students from other higher education institutions, in particular the state community colleges), plus another private investment of $1 million for the development of the high school partnership component. Further funding comes also from the cost savings achieved thanks to the e-Advisor.

Enhanced graduation rates lower the costs incurred for instruction. Due to the about 720 additional students who graduated earlier in 2012 thanks to the e-Advisor and other innovations, the university saved $6.5-$6.9 million in instruction costs. Also, more than $1 million annually in instructional costs was saved due specifically to the innovations in math adaptive learning courses. Gross tuition revenue gains due to increased retention since inception are estimated at approx. $9 million. In the absence of the e-advisor and the other innovations, greater costs would be incurred due to the need for additional advisors, if the same outcomes were to be achieved in terms of increased retention and graduation. To achieve the same results as those realised at the current average of 1 advisor per 350 students, that ratio would need to be 1 advisor to 200 students and would cost the university about $3.7 million annually.[27]

In addition to the savings achieved through the introduction of the e-Advisor, the university gained financial benefits from its online courses: "It is ASU's hope that ASU Online will become the first national comprehensive public university fully online. In order to fulfill this goal, they partnered with private sector businesses that helped provide the capital to rapidly scale the initiative. **ASU Online began enrolling students in 2007-08 and just three years later about 3.1% of total tuition revenues for the entire university—or $22 million—came from ASU Online. By FY20, ASU projects that approximately 9% of its tuition revenue—or $130 million—will be from ASU Online.** In fact, even though ASU suffered from large state budget reductions that resulted in resident tuition increases, growth in non-residents, international and ASU Online students helped to moderate the increase. ASU provides a good example of how partnering with private businesses can help provide the

27 Interview with Sheila Ainlay, Executive Vice-Provost for Planning and Budget, May 10, 2013.

capital to scale quickly and in return reap the rewards of revenue to insulate state residents from tuition increases during economic downturns" (Fishman, 2013).

A2: Understanding of the context

The context in which the practice is developed (institutional, technological)

Institutional context

The US rank in terms of college completion rate among adults aged 25-34 has fallen in recent years from 12th to 16th, according to an OECD report, the country lagging behind global leaders like South Korea, Canada and Japan (de Vise, 2011). These results came two years after President Obama's 2009 pledge to regain the world lead by increasing American degree attainment to 60% by 2020, suggesting that much remains to be done to achieve this objective. Accelerated progress on several fronts is needed, including: increasing access to college, helping more students graduate, and improving the quality of the student learning experience, all in a context of scarce public resources. Moreover, new innovative, cost-effective approaches to teaching and learning will need to be adopted by universities, especially using information technology (Fishman, 2013).

Universities that have embarked on this endeavour, also known as "Next Generation Universities" or "Next Gen U" (Selingo, 2013), are using technology to enrol, teach, and graduate more students, embrace a holistic online student experience by offering not only online courses (either hybrid or fully online) and credentials, but also student services like early warning systems, counselling and support, financial aid, and even library and research services. A key advantage of technology-enhanced education is the potential to lower costs, while serving an increasing number of students.

ASU is one of these "Next Gen U", which have been successful fully utilising technology to improve learning and manage costs (Fishman, 2013) and made its mark as "a hot-bed of data-driven experiments" (Parry, 2012). In his inaugural address in 2002, ASU President Michael Crow stated the university's commitment to the success of each unique student as one of his primary goals. This goal has been pursued steadfastly, through expanding university access and graduating more college graduates with higher capacity to fuel the state's and the nation's economic engine. President Crow organised a team dedicated to transforming ASU's vision from "school-centred" to "student-centred" and "customized education," led by Executive Vice President and Provost Elizabeth Phillips. The team focused on creating new programmes, personalised learning technologies, an online learning environment and innovative transfer partnerships to give ASU students an educational experience focused on developing their talents and aptitudes and preparing them to graduate and enter the workforce or further their education (ASU Annual Report 2012)[28] - see Table 1 below.

Table 11: Educational innovation at ASU

Tool	Description
e-Advisor	ASU is leveraging data and predictive analytics to map out courses for individual students' degree programs, monitoring progress, enhancing student success and increasing retention.
Adaptive learning	By partnering with Knewton, ASU has introduced computer-aided instruction in entry-level math courses, helping professors adapt their presentations to the students' learning needs, as indicated by their responses to questions and tasks. In 2012, 6,523 students took Knewton-powered courses, with the pass rate jumping from 66 to 75%. The system is being expanded to six additional general education courses.
ASU Online	Almost 9,000 students are enrolled in one of 60 undergraduate or graduate programs available entirely online at ASU. ASU has implemented more than 40 cutting-edge learning technologies into its online programs. Enrollment grew by 287% in 2012. U.S. News & World Report ranks ASU No. 1 in online student services and technology.
ASU SkySong	ASU's innovation center in Scottsdale helps grow the economy by launching and accelerating new companies and promoting use-inspired research, in collaboration with local communities, state government and business partners. According to a recent study by the Greater Phoenix Economic Council, SkySong and its tenants generate an annual economic impact of $113.6 million.

Source: ASU News (2013).

Within the university structure of academic and non-academic departments, the "student-centred" approach has been applied to reform the academic departments, and efforts are currently being made to extend the approach also to the non-academic departments[29]. ASU has earned a reputation as one of the nation's most progressive institutions of higher education by making innovation part of its core mission (ASU News, 2013)

An important determinant of ASU's "student-centred" vision is the fact that the university is the country's largest public university (74,000 students), and also Phoenix's only public university, with a very diverse student body. As such, the university is accountable to the tax payer and strives to achieve the best results for the funding it receives. It is also committed to giving students wide access to education and high quality education resources, and ensuring their success in the workplace. Educating large masses of students, providing every student with quality education and producing more college degrees at more affordable costs is a major challenge, to which the university provided an innovative solution: the use of technology.

[28] http://annualreport.asu.edu/student-success.html
[29] Interview with Elizabeth Philips, ASU Executive Vice President and Provost, May 8, 2013.

It is in this context that ASU decided to enter the market of online courses, while also keeping and developing their campus courses, thus having access to both online and campus markets. ASU Online – the university's platform created in 2009 for delivering complete certificate and degree programmes online - currently offers a total of 56 undergraduate and graduate degrees with additional programmes under consideration (see all online programmes at http://asuonline.asu.edu/degree-programs). ASU Online serves approx. 7,000 students enrolled for online courses, while approx. 67,000 students are enrolled for campus courses[30].

Online courses are targeted at non-traditional students and those looking for flexible class schedules (e.g. students who already have several hours of transfer credit and are working toward their degree while maintaining a job or caring for a family). Online courses are shorter than the traditional campus course of 15 weeks and five classes. The 15 weeks were split in two 7.5 weeks both for online and face-to-face classes, each with three courses, resulting thus in a total of six courses taken instead of five. The outcome is more education in less time and better learning results. Both online and campus courses benefit from excellent resources offered through the university's portal for courses and student activities MyASU. The e-Advisor works equally for both online courses and campus courses. ASU students often combine face-to-face, hybrid, and fully online courses to ensure the successful completion of their courses and graduation in four years.

The demand for online and hybrid courses that combine both online content and instruction with in-person interaction and engagement with the professor and classmates is on the rise. Since fall 2011, the academic colleges have graduated 505 students through ASU Online-managed programs with support from companies such as Pearson and Academic Partnerships. Future prospects include entering the international marketplace by targeting foreign national students interested in an American university with an alternative learning option. Another target is the military personnel who may be considering a college degree (ASU Annual Report 2012).

The university's determination to enrol, teach and graduate more students also stems from a strong awareness of the social and economic impact of college graduates. For example, in Arizona, the average earning of those with a college degree is approximately $28,140, which is about 73% higher than the earning of those with only some college. A 1% increase in the proportion of the workforce with a degree in Arizona relative to the actual figure would lead to an additional 30,320 workers with a bachelor's degree. Aggregate earning would be $853 million higher, resulting in increased spending at Arizona merchants and increased tax collections by the Arizona government. The labour market impact of college graduates is also significant: college graduates have longer and more persistent attachment to the labour force

[30] Interview with Kent Hopkins, ASU Vice Provost for Enrolment Management, May 8, 2013.

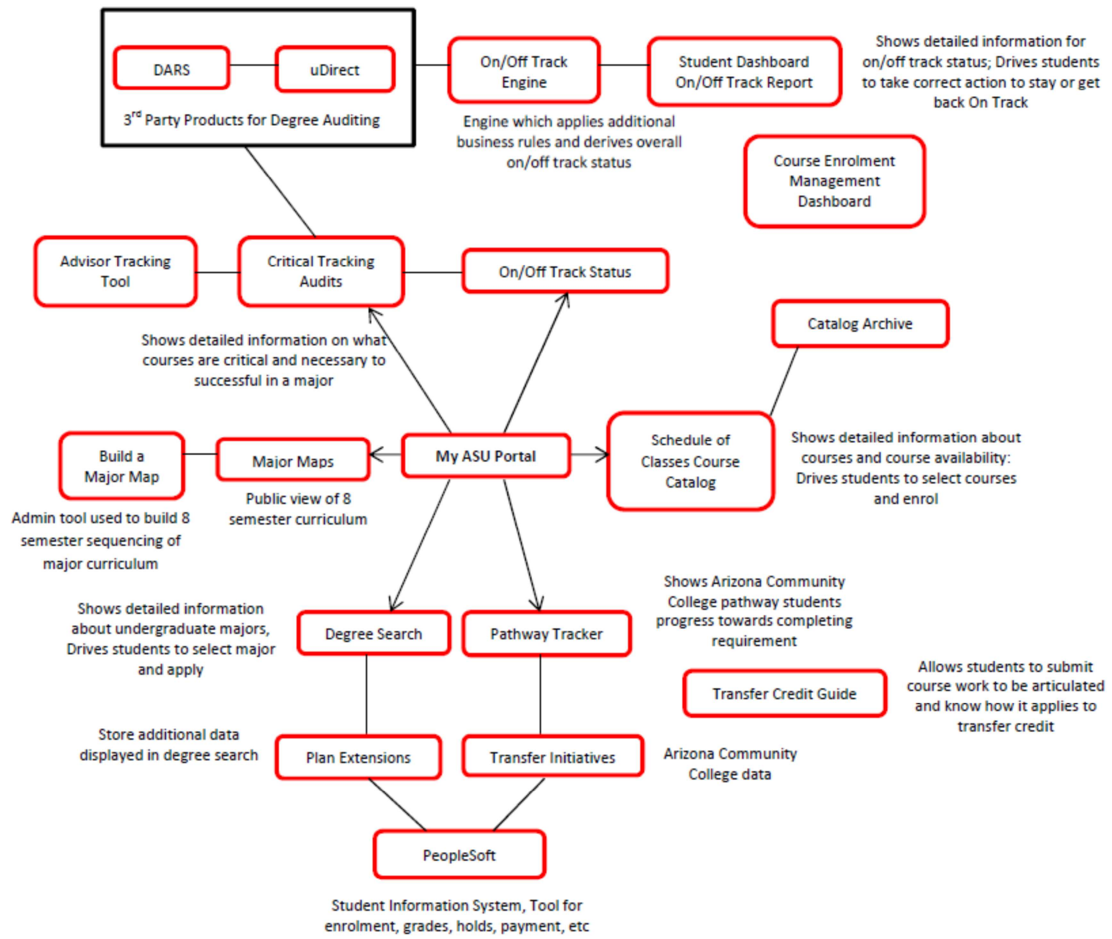
and much lower unemployment rates, an effect that holds true even for those who do not complete college. College graduates enjoy higher incomes, and see their income grow as they age. College graduates also enjoy higher social-economic mobility. College is the surest way to escape low income status[31].

Technological context

The e-Advisor includes a variety of tools aimed to provide information about students and their academic progress (see Fig. 1 and annex D3). All applications have been written in Java at ASU, for ASU. Some of the most important tools are briefly described below. Views of screenshots for each of the e-Advisor's functions (Identify, Plan, Monitor, Feedback, Enforce) are available at https://eadvisor.asu.edu/whatiseadvisor/tracking

[31] Interview with Arthur Blakemore, ASU Senior Vice provost, May 8, 2013.

Figure 11: e-Advisor tools



- *Build a Major Map*: constructs an eight-semester view of curriculum majors;
- *Plan extensions*: stores additional data and updates once a year;
- *Transfer Credit Guide*: allows students to submit course work for transfer credit. It is a relatively new feature developed in the last eight months and is still growing;
- *uDirect* (previously called Degree Completion Planner DCP): used for sequencing the curriculum and marking courses as "critical" and "necessary";
- *The Dashboard*: provides analytics about students' track status and shows their progress at all times. It thus helps not only the students to stay on track, but also the academic advisors to check student progress and the academic administrators to check which faculty members are best at keeping students on track.

Interesting technology insights are also provided by the **ASU's adaptive learning programme**. This is based on the university's partnership started in 2011 with Knewton, a for-profit company which developed an adaptive-learning platform for remedial math. The problem of math is important because student retention and graduation are highly dependent on success in a student's first math class. For example, students who have earned below a "C" in developmental math have a 49% retention rate and only a 20% six-year graduation rate. Students who earned a "C" or better have an 81% retention rate and a 50% six-year graduation rate (ASU Annual Report 2012).

Several sections of remedial math at ASU were moved to this platform. Although it is online, students still meet together in a lab and work through the activities with an instructor present. Incoming ASU freshmen are now required to take an online math placement test to determine their levels of competency. Based on their scoring, they are then placed in a corresponding level class. Those in need of a little extra help are positioned in Enhanced Freshmen Math, a self-paced learning environment that provides each student with the personalised learning tools needed to succeed. The Knewton interface was developed to have the look and feel of a video game or app, making it a comfortable environment for students. Additionally, Knewton is personalised to students, working at their pace. If a student clearly understands a concept, shown by answering problems correctly, Knewton moves on to another concept for the student to master. This allows students to progress through the course at their own pace, allowing them to finish the class and enter credit-bearing work even before the semester is over. Data have shown that the portion of students withdrawing from math courses fell from 13% to 6%, and pass rates rose from 66% to 75% (ASU Annual Report 2012).

The most important pedagogical features of the math programme are centred on the fact that course success is based on mastery of the subject matter rather than percentage grade points in self-paced format[32]:

- To receive a C grade, students must master 100% of all skills at a certain proficiency level;
- It is no longer possible to pass the course with holes in one's knowledge ("the Swiss cheese approach");
- At all times, both the student and the instructor know exactly what the student has mastered;
- Students can accelerate their progress through the material;
- Both an individualised and an interactive learning environment is stressed;
- Applications are stressed to improve critical thinking.

[32] Interview with Arthur Blakemore, ASU Senior Vice Provost and Philip Regier, Executive Vice Provost and Dean, May 9, 2013.

A3: Challenges and identification of the specific drivers behind the innovation initiative

The challenges that the initiative aims to address

The initiative addresses the changing supply of and demand for higher education. Supply-side developments enable the provision of new services and improvements to existing ones. The opportunities provided by new learning technologies and related developments are a good example, as well as the changing demands and expectations from a new generation of students, already equipped and experienced in the use of social media with lifestyles shaped accordingly. A further set of challenges arises from the combination of new expectations and opportunities with the traditional structures and cultures of higher education institutions, which may be broadly summarised as the challenge of managing institutional change. Not least of these is the quality of creative freedom for both staff and students to create and apply knowledge which will enable them to be innovators in all life situations thereafter.

On the demand side, challenges arise from the changes and developments in the expectations placed upon higher education's users and consumers by other groups and stakeholders in the societies of which they are a part. These include for instance changing needs of employers regarding the numbers and kinds of graduates, or changing needs in the development of workforces, with growing demands for lifelong learning and work-based learning. Other changes can refer to the needs and expectations of students and the increasing diversity of these needs, e.g. students' financial circumstances, the needs of many to combine paid work or domestic duties with their higher education studies, anxieties about employment opportunities after graduation, for some a desire to travel and for others a desire to remain at home, as well as changing preferences in terms of subjects of study, study methods and the extent of engagement with the non-academic features of university life (Eurostudent 2012). More generally, these changes regard growing demands for knowledge transfer in a variety of forms, and require new partnerships between higher education and other organisations, often embracing innovative combinations of knowledge production, knowledge transmission and knowledge transfer.

It becomes clear from the definition of these two types of challenges that the e-Advisor meets both of them, due to its high potential to increase retention and graduation rates, improve the learning process and the students' academic performance, give students more freedom and choice in the learning process, better understand their individual needs and circumstances, and ultimately increase the quality of their education and their employability success.

The immediate cause for developing the initiative

The immediate cause for developing the e-Advisor is the ASU's drive, as one of the "Next Gen Us" to use technology to enrol, teach, and graduate more students, to provide better education delivery, content and student support services, and offer students a high quality teaching and learning experience. At the ASU, these objectives have been embedded in the university's shift from a "school-centred" to a "student-centred" vision of higher education, under President Michael Crow's leadership.

Part B: The higher education innovation system: functions, components and relationships

B1: Analysis of the functions

The function to which the innovation is related

The e-Advisor addresses specifically the education function of the ASU's higher education system, and in particular such sub-functions as teaching and learning, curriculum development, assessment and student mobility.

- **Teaching and learning**: the e-Advisor intervenes in several stages of the student's academic life. For example, in the choice of a major, the system allows students to search for a major via an application called "Degree Search", which is student friendly and allows keyword queries. For example, a student may enter "interested in people" and all majors relevant to this interest appear on screen, along with their requirements. Students can thus explore the requirements of different majors of their interest whenever and wherever they want, without needing to involve an academic advisor until they have narrowed their search. Another case is the choice of courses that a student can take in order to graduate in a major, as the e-Advisor is always up to date and can accurately match the courses to the requirements of the student. Yet another case is when the student fails to meet the course requirements. In this case, the system generates an alert to both the student and the advisor, and provides indication on optimal choices for the student to get back on track. A built-in feature of the system is that a student who is off track twice will need to change the major, but the academic advisor can allow the student to continue in their major if there is a good reason for their being off track (e.g. financial trouble, death in the family, personal issues, etc.) (Phillips, 2013).
- **Curriculum development**: the system has complete information on the courses that are highest and lowest in demand, and so the academic administration can reinforce or diversify those that are most successful and 'clean out' those that are not very popular, by asking the academic departments to review their teaching programme.

- **Student mobility**: the e-Advisor supports student mobility through a component that was recently developed with the support of a $1 million grant from the Kresky Foundation, i.e. the **partnerships with community colleges inside and outside the Arizona state.** Two of ASU's signature community college collaborations are **the Maricopa to ASU Pathways Programme (MAPP)** and the **Transfer Admission Guarantee (TAG) programme**. The MAPP and TAG programmes provide a clear path for community college students to earn a degree at ASU, requiring them to obtain their Arizona General Education Curriculum (AGEC) and the appropriate associate degree before transferring. The MAPP and TAG programs are available at all public community colleges in the state (ASU Annual Report 2012).

Impact of the innovation on other functions

There is no evidence of the e-Advisor's impact on other functions of ASU's higher education system, such as research and "third mission".

B2: Analysis of the components

Identification and description of actors involved

The e-Advisor is part of a broader set of innovative initiatives implemented at ASU under the leadership of President Michael Crow, involving a dynamic institutional team, comprising a senior management team, academic advisors and faculty members.

Beyond the university actors, there is also a broad community of external stakeholders, including firms (e.g. the non-profit firm Knewton that developed the adaptive learning programmes), foundations (Kresky Foundation, Lumina Foundation, etc.), state community colleges and their students who come to ASU to take a degree (as shown above, approx. 13,000 students from the state of Arizona have come to ASU for a degree since fall 2009).

Implementation of the initiative

See details in the previous sections.

Table 12: Actors/stakeholders, level of operation, roles and responsibilities and activities

Actor/stakeholder components	Level (macro, meso, micro)	Role/responsibility	Activity
Internal stakeholders: ▪ ASU institutional team: President, Executive Vice	Micro and meso	▪ Institutional leaders; ▪ Curriculum development; ▪ Development of the e- Advisor, ASU	▪ University policy-making and administration; ▪ Planning and

President and Provost, Senior Vice Provosts and Vice Provosts, directors of various university offices, etc. ▪ ASU faculty and administrative staff; ▪ Academic advisors; ▪ ASU students, ▪ Students' parents		Online and adaptive learning; ▪ Mobilising resources; ▪ Teaching; ▪ Academic advising; ▪ Learning; ▪ Building partnerships with community colleges and other external actors	allocation of university resources; ▪ Identification of partner institutions; ▪ Transfer of students' records for the partnerships with community colleges; ▪ Negotiation/ MoUs
External stakeholders: ▪ AZ state authorities; ▪ Community colleges; ▪ Foundations (e.g. Kresky, Lumina); ▪ Business firms (e.g. Knewton); ▪ Transfer students from the community colleges	Meso	▪ Partnership building;	▪ Financial investment; ▪ Provision of technology and services; ▪ Student recruitment

B3: Analysis of the relationships

The nature of the relationship

The e-Advisor has influenced both the financial and non-financial dimensions of the relationships between the different actors involved in the design and application of this initiative. From a financial standpoint, the use of the e-Advisor has allowed significant cost savings for the university and better allocation of existing financial resources. From a non-financial standpoint, one can note the good collaboration and communication within the university institutional team, the dynamic progress made in partnerships with the community colleges, the successful attraction to ASU of students from all over the state, etc.

Changes in existing relationships

Collaboration and networking in the ASU higher education system are particularly intensified by the use of the e-Advisor.

Impact of the relationships on the innovative practice

Table 13: Relationships between actors

Actor 1	Actor 2	Relationship	What changed?
Students	Academic advisors	Academic advising	The e-advisor facilitated the interaction between the student and the academic advisor in terms of the choice of a major, tracking student progress and finding solutions for the student in case of going off track.
Students	University administration	Allocation of university facilities and instructors	The e-Advisor facilitated the allocation of university facilities and instructors (e.g. number of seats and instructors for critical courses, cleaning of courses that are low in demand, etc.)
ASU	15 Community colleges in AZ	Partnerships for the transfer of students to ASU	The e-Advisor transfer of students facilitated the transfer of student records from the community college to ASU. Any change in the student profile is immediately visible in the system.

B4: Cross-elements analysis

Mapping the system and stakeholders

The major stakeholders of the ASU higher education system and their interactions in the implementation of the e-Advisor are illustrated in Fig. 2 below.

Figure 12: Stakeholders and interactions in the implementation of the e-Advisor

Conclusions related to the innovation system map

The implementation of the e-Advisor is based on a mix of top-down and bottom-up approaches in the ASU. Both vertical and horizontal authority lines are at work within the ASU, and a horizontal cooperation between ASU and various external partners. The benefits of this interaction are spread over all the stakeholders, in particular the students, in line with ASU's "student-centred" vision of higher education.

Part C: Outcomes, assessment and conclusions

C1: Conclusions: Assessment of outcomes in terms of expected and unexpected consequences

Barriers and bottlenecks

The technical complexity of the online system, the need for permanent updates of the system with the related databases (e.g. national employment and salary statistics), low awareness of potential students of the requirements of academic life, choice of a major, etc.

Influence of the context on the success of the initiative

The innovative environment and vision of ASU and the dedication of the institutional team have been two major success factors of the e-Advisor.

Outcomes and results

The main measurable outcomes and evaluation results of the e-advisor are the increases in the student retention and graduation rates, in the ASU enrolment numbers (including students transferred from the community colleges, etc.) and in the cost savings achieved by the university.

Transferability

The initiative is suitable for transferability, particularly to other universities that grant degrees based on the major/minor principle. This principle is less frequent in Europe. However, other features of the e-Advisor can be a useful instrument to apply/adapt to the student advising and monitoring systems, especially with regard to the academic advising process and the allocation of university facilities and instructors.

Part D: Annexes

D1: List of literature used

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D2: List of persons who contributed to the case study

Name	Organisation	Country
Michael Crow	ASU President, ASU	United States
Elizabeth D. Phillips	Executive Vice President and Provost, ASU	United States
Arthur Blakemore	Senior Vice Provost, Office of the Provost, ASU	United States
Kent Hopkins	Vice Provost for Enrolment Management, ASU	United States
Arthur Blakemore	Senior Vice Provost, Office of the Provost, ASU	United States
Frederick C. Corey	Vice Provost, Dean, University College, and Director, School of Letters and Sciences, ASU	United States
Philip Regier	Executive Vice Provost and Dean, ASU Online and Extended Campus, ASU	United States
Maria Hesse	Vice Provost for Academic Partnerships, ASU	United States
Sethuraman (Panch) Panchanathan	Senior Vice President of the Office of Knowledge Enterprise Development, ASU	United States
Sheila Ainlay	Executive Vice Provost for Planning and Budget, ASU	United States
Jennifer Malerich	Senior Director for Curricular Activities and Action, ASU	United States
Barbara Sowden	Senior Director, Development, University	United States

	Technology Office, ASU	
Victor Yellen	Consultant, ASU	United States

The development of Learning Analytics at the University of Derby (UK), University of Amsterdam (the Netherlands) and Purdue University (US)

Author: Mr Simon Broek

Overview:

a. **Driver:** The creation and implementation of Learning Analytics (LA) has been driven by the changing supply of and demand for higher education. This includes the use of technology to improve students' performance and students' experience targeting specific aspects such as engaging students with learning/university life; increasing the efficiency of teaching and reducing drop outs; providing assistance to students in becoming self-directed learners; and tackling retention and longer graduation periods; the initiative also finds a driver in the changes in higher education funding, with the massification of higher education posing crucial challenges for the financial sustainability of the sector and prompting institutions to use technology to provide old services in new, more cost-effective ways.

b. **Strategy**: LA is a sub-strategy of academic analytics (data analysis to help educational institutions monitor their progress with regard to key institutional objectives, such as student retention, faculty productivity, and the impact of outreach and engagement), and differs from academic analytics as LA's focus is not so much on the institutional goals, but on the student. It uses data to inform students about their own progress, taking a student-centred approach in times of massification.

c. **Outcome**: The outcome has been the implementation of learning analytics and actionable intelligence.

d. **Key factors for success**: There are no particular factors for success, however, it appears the institute using LA should know exactly how the LA system works: hence there is a preference for developing the system oneself instead of obtaining a turnkey solution;

e. **Implementation Challenges**: to converge (migrate) 'data silos' from different university departments (student affairs, departments, online learning environments); to identify which data are needed to provide a risk profile of a student; coordination and involvement of different actors from different sectors; technology-oriented and innovation-friendly users (teaching staff and students); privacy;

f. **Main changes**: Academic staff use the technology to improve their course and to improve the tracking of student performance early on to identify those at risk.

g. **Results:** In general, increased understanding of student learning behaviour. More specifically, students who attended at least one Signal Course (Purdue University (US)) are retained at rates significantly higher than their peers who had no Course Signals courses; students report positively on Course Signals (89%); they would like to use CS in every course (58%).

Part A: Setting the scene: introduction, challenges and contexts

A1: Introduction / definition of the innovation initiative

Overall objectives of the initiative and future plans

LA is a tool that uses data analysis to inform decisions in the education sector (including but not limited to higher education). The main principle of LA is 'to leverage student-related data to build better pedagogies, target at-risk student populations, and to assess whether programs designed to improve retention have been effective […]'[33]. Academics and educators mostly benefit from it by understanding better how students interact and relate to coursework, while students can access specific data tailored to their needs. LA has been implemented in several institutions across the continents from Europe, to US and Asia. The concrete examples which are focused on are:

- **Purdue University (US)** has implemented Course Signals to increase student success in the classroom. Purdue University's Course Signals application detects early warning signs and provides intervention to students who may not be performing to the best of their abilities before they reach a critical point. Course Signals is easy to use, it provides real-time, frequent and ongoing feedback. Furthermore, interventions start early - as early as the second week of class.
- **The University of Derby (UK)** explored the strategies to improve the student enhancement processes by addressing key questions such as: 1) What is actually happening to students, how can we find out? 2) What are the touch points between students and the institution? 3) What are the institutional "digital footprints" of the students? 4) What really matters to students?
- Initiatives in the field of LA have also started up in the Netherlands.[34] The case will study the most advanced university: **University of Amsterdam (UvA).**

Purdue University Signals

Course Signals (CS) is a student-success system that allows faculty to provide meaningful feedback to students based on predictive models. The premise behind CS is fairly simple: to utilise the wealth of data available at an educational institution, including the data collected by instructional tools, to determine in real time which students might be at risk, partially indicated by their effort within a course. Through analytics, large data sets are mined and statistical

[33] NMC (2013), NMC Horizon Project Preview 2013 K-12 Edition, p. 2.

[34] In 2012, for example, Dutch higher education institutions experimented with learning analytics within seven pilot projects subsidised by SURF, a network which unites Dutch higher education institutions to improve the quality of higher education and research via innovative collaborative projects.

techniques are applied to predict which students might be falling behind. The goal is to produce "actionable intelligence" —in this case, guiding students to appropriate help resources and explaining how to use them.[35]

At Purdue University a group tried to build a simple early warning system, by making use of three sets of indicators:

1. Demographic indicators related to a risk profile
2. Performance data (standardised test scores)
3. Interaction data in the virtual learning environment (VLE)

A predictive student success algorithm (SSA), run on demand by instructors, determines a risk profile of the individual students and reports this profile in the form of a traffic light (red, yellow, green), together with tailored messages to stimulate the students to take further action. The development of the algorithm was true ground-work, finding out which indicators have the most explanatory power. It took two-three years to develop the first automated system (launched in 2007).[36]

Future steps include further research in how messages to students are phrased.[37] It appeared that the tone of the messages to students on how they progress is essential in reaching them and activating them. Also, the Course Signals should be used in more courses.

Derby University[38]

Being relatively successful with widening participation initiatives, Derby has a very diverse student body with fewer than 50% of students coming straight from school. The student population contains an above average number of students who are 'first in family', those carrying caring responsibilities (hence the university attracts a lot of locally-based applicants), students who declare a disability, many of whom have support plans in place and also a significant number of mature students, who may be returning to learning after many years outside of the education sector. Factors such as these are known to predispose students to be more likely to have a depressed student performance and retention rate (Bowl 2003). Indicators of engagement can help staff recognise where students from non-traditional backgrounds are falling away from their studies, failing to settle into their life at university or not achieving their full potential.

[35] Arnold, K. E. 2010. Signals: Applying academic analytics. EDUCAUSE Quarterly, 33, 1. www.educause.edu/library/EQM10110

[36] Videos explaining the Course Signals system concern: John Campbell presentation during 'De onderwijsdagen 2012': http://www.youtube.com/watch?v=L3NZBiAnsMs&list=PLwel1L5Gi6O8zz2Dr7mugsOst_7qoAFv_&index=11 ; Introduction to Course Signals: http://www.itap.purdue.edu/learning/tools/signals/faq/index.html

[37] The messages should be action-oriented, relate to the specific situation the student is in and should differ over time (non-standardised messaging).

[38] Mutton, Jean, Hibbert, Jake, (2012), Engagement Analytics – scoping early indicators for spotting students 'at risk'.

Service design and enhancement techniques are applied to three aspects of the student lifecycle: 1) induction, 2) learning and teaching and pastoral care in order to improve retention, 3) progression and completion through identification of early indicators of students 'at risk'. Aspects of the student journey were mapped using service blueprinting, and student personas and storyboarding were employed to better understand how and when timely interactions and interventions could support and re-engage students.

The project has increased understanding of operational processes as well as scoping out the data requirements for a 'dashboard' of indicators which will shed light on (the lack of) student engagement. This is in relation to both students' academic studies and to their wider connection with university life. At the outset the project anticipated that it would be scoping out the requirements for one data dashboard which would be of use to *staff* in a pastoral role, e.g. personal tutors. As the project progressed, it became apparent that there would be an appetite for a *student-facing product* also. It also became increasingly clear that different types of staff would require different sets of information and the shape of the product began to form. Ideally the data dashboard would be customisable and would offer the opportunity for staff to have meaningful conversations with students which would add value to the tutor/student relationship.

This approach has been called 'engagement analytics' as the team looked to go beyond the 'hard data' capture of 'LA' already in use around the sector (this may include footfall in the library, access to the VLE, attendance monitoring, etc). In viewing the student experience going beyond the classroom, the team worked with a range of stakeholders to take account of engagement indicators relating to a student's sense of 'habitus' or belonging, which can play just as important a part in their overall felt student experience, such as being a student representative, volunteering, transfers between modules or subjects of study, time out, resilience and preparedness for study, etc.

Through this work, the project has informed wider policy discussions regarding student perceptions of engagement, value added, non-continuation, non-completion, achievement, efficiency, business intelligence, the data journey and quality standards. The outcomes of the SETL project will be of value to members of the wider higher education community who are designing and enhancing services to students; seeking to engage students as co-designers of their own experience, and seeking to develop effective approaches to identify and support students at risk of withdrawal, non-completion or not progressing at the pace intended at enrolment.

The future work concerns:

a. studying what data is most relevant to facilitate the tutor-student interaction, to drive tutorial dialogue with the students

b. developing the ICT system including the data on student interaction, developing a dashboard to present and visualise the student journey data (patterns of engagement)

University of Amsterdam[39]

The Dutch University of Amsterdam (UvA) and the Free University of Amsterdam (VU) received a fund from SURF to conduct a pilot study on user requirements for LA. It looked into ways to use data to make visualisations to inform teachers on 1) the use of e-learning material by students; 2) the order in which the learning material is used; and 3) whether there is a relationship between the number of materials used and the study results. In addition, the project investigated the opinion of students on LA, the way they would like to receive feedback on their learning behaviour, and finally their stand-point on privacy issues.

Future plans concern further exploration of the use of LA. A second research grant will be assigned for the development of a student dashboard which relates the students' own performance to the performance of other students.

In a way, the use of data to inform the dialogue between teacher and student on a student's progress is not new; however, due to the larger number of students, there is no time for these types of one-to-one interactions. With the use of online learning management platforms, more and more data are available that can be used for the purpose of tracking student progress. The technology in that sense is an 'enabler of change'. The change, the innovation itself is how academic staff use the technology to improve their course and to improve the tracking of student performance early on to identify those at risk.

There are differences in the approaches studied. Where the Purdue Course Signals system has a more academic analytics outlook, focusing on a course level, the Derby SETL (Student Experience Traffic Lighting) project had a much broader perspective as it focused on the whole student journey through university life. They found out that other softer, subjective indicators are good predictors of whether a student is engaged in university life. The students that are considered 'loners' have a much higher risk of dropping out than the students that are active in university life. The system would, in that sense, be more innovative as it not only replaces something existing, but adds a pastoral function to the student administration services. This is especially important for Derby University, which is particularly strong on the widening participation agenda, opening up university to students from disadvantaged backgrounds.

[39] The developments at UvA should be seen in a broader movement in the Netherlands focusing on LA. SURF has established a Special Interest Group (SIG) and funded a number of initiatives in different universities to experiment with learning analytics. During the recent Learning Analytics Summer Institute 2013 (LASI 13: http://lasiamsterdam.wordpress.com/) 40 participants from different disciplines were present. It was emphasised that LA should be seen in close relation to Instructional Design (http://lasiamsterdam.wordpress.com/resources/instructional-design/), meaning that Learning Analytics practices should commence with clear ideas about the instructional practice and course design.

There are many students who have a higher risk profile as they are for instance the first in the family to enter university.

Outcomes of the practice

Only concerning Course Signals concrete results can be reported in terms of student retention. Both the Derby and Amsterdam initiatives are not yet in an implementation phase. However, the following lessons have been learnt in all cases:

- The technique is an 'enabler of chance' not the innovation itself. The true change is the institutional attitude towards instructional design, putting the student at the centre of the education process.
- Students in their first year need particular assistance in becoming self-directed learners.
- Existing data sets are not fit for purpose and hence need work to make them fit LA systems.
- Both students and academic staff are generally supportive towards LA. Both in Amsterdam and Derby, more resistance was expected to using student data. Students see the benefit of having an overview (visualisation) of their study activities and this overview can encourage them to invest more in their studies.

At Purdue the results are much more tangible in terms of student success. One performance measure of student success is the final course grade. Research indicates that courses that implement CS realise a strong increase in satisfactory grades, and a decrease in unsatisfactory grades and withdrawals. Individual courses see variable success with: an increase in As and Bs ranging from 2.23 to 13.84 percentage points; a decrease in Cs ranging from 1.84 to 9.38 percentage points; and a decrease in Ds and Fs ranging from 0.59 to 9.40 percentage points.[40] Combining the results of all courses using CS in a given semester, there is a 10.37 percentage point increase in As and Bs awarded between CS users and previous semesters of the same courses not using CS. Along the same lines, there is a 6.41 percentage point decrease in Ds, Fs, and withdrawals awarded to CS users as compared to previous semesters of the same courses not using CS.

According to the analysis conducted by Arnold and Pistilli[41], students who began at Purdue in fall 2007, 2008, or 2009 and participated in at least one CS course are retained at rates significantly higher than their peers who had no CS classes but who started at Purdue during

[40] NB: Academic grading in the United States most commonly takes on the form of five letter grades. Traditionally, the grades are A, B, C, D, and F—A being the highest and F, denoting failure, the lowest.
[41] Arnold, Kimberly E., Pistilli, Matthew D. (2012) Course Signals at Purdue: Using Learning Analytics to Increase Student Success: LAK'12, 29 April – 2 May 2012. In this article more results are presented on Course Signals.

the same semester. Further, students who have two or more courses with CS are consistently retained at rates higher than those who had only one or no courses with Signals.

The CS works particularly well to raise the performance of lower-performing students: in non CS courses around 15-17% of students dropped out, in CS courses only 5%. In addition, higher grades are acquired. Grades raise from Ds to Cs and Cs to Bs. There are not more A grades. The reason for this last point is that CS particularly helps students to become self-directed learners. In order to obtain A or B grades, one already needs to be highly self-directed. Therefore, the additional support students receive from the CS systems does not further assist them in this.

The CS has been running from 2007 and has gathered feedback from 1,500 students participating in CS courses. According to the analysis of Arnold and Pistilli, "students report positive experiences with CS overall (89% of respondents stated CS provided a positive experience and 58% said they would like to use CS in every course). Most students perceive the computer-generated emails and warnings as personal communication between themselves and their instructor. The emails seem to minimise their feelings of "being just a number," which is particularly common among first-semester students. Students also find the visual indicator of the traffic signal, combined with instructor communication, to be informative (they learn where to go to get help) and motivating (74% said their motivation was positively affected by CS) in changing their behaviour."[42]

[42] Arnold, Kimberly E., Pistilli, Matthew D. (2012) Course Signals at Purdue: Using Learning Analytics to Increase Student Success: LAK'12, 29 April – 2 May 2012. In this article more results are presented on Course Signals.

Table 14: Retention Rate for the 2007, 2008, 2009 Entering Cohort

Number of CS Courses	2007 Entering Cohort					2008 Entering Cohort				2009 Entering Cohort		
	Cohort Size	Year of Retention				Cohort Size	Year of Retention			Cohort Size	Year of Retention	
		1 Year	2 Year	3 Year	4 Year		1 Year	2 Year	3 Year		1 Year	2 Year
No CS	5.134	83.44%	73.14%	70.47%	69.40%	4.221	81.69%	75.08%	73.21%	3.164	87.67%	81.89%
At least 1	1.518	96.71%	94.73%	90.65%	87.42%	2.690	96.25%	89.55%	85.17%	2.962	90.34%	83.22%
1 instance	1.311	96.57%	94.13%	89.70%	86.50%	2.125	95.62%	88.00%	83.58%	2.296	87.72%	80.87%
2 or more	207	97.58%	98.55%	96.62%	93.24%	565	98.58%	95.40%	91.15%	666	99.40%	91.44%

A2: Understanding of the context

The context in which the practice is developed (institutional, geopolitical, regulatory)

The use of student data to improve education performance is not a new phenomenon. The term 'academic analytics' refers to the analysis of data to help educational institutions monitor their progress with regard to key institutional objectives, such as student retention, faculty productivity, and the impact of outreach and engagement.[43] Many HE institutions world-wide make use of analytics for this purpose. LA differs from this concept of academic analytics as the focus is not so much on the institutional goals, but on the student; LA uses data to inform students about their own progress: LA is therefore essentially a feedback loop.

When assessing in which context the use of LA emerges, there is not a single set of factors that can be identified as being preconditions. Even more, its emergence depends more on individuals and personal interests than institutional or regulatory policies. Of course, an essential precondition to develop a LA system is the use of online learning platforms such as Blackboard and Moodle. A close investigation is however needed to distil what kind of data can be obtained from these platforms and what data is needed for providing valuable feedback. Also, the innovation is more related to detailed ground-work and continuous experimentation (trial-and-error) than top-down implementation of an innovative practice. Examples are provided below from the three institutions studied.

At Purdue University, developments started very low profile by a small group around John Campbell, an IT-interested academic. The work continued in the ITaP group (Information Technology at Purdue). In Derby, the LA work is the result of a service design approach in which the key question is what really matters to stakeholders (i.e. students). Therefore, the project had no preconception about what the final product would be and called for the broad involvement of students in the development phase (what they would need in order to improve their engagement with studying at Derby University).

In Amsterdam, experimenting with data and developing useful visualisations for teachers and students resulted in the finding that data from the learning management system was incomplete and not rich enough to build meaningful visualisations. For instance, it appeared that the system only records that a student opens a learning source the first time, hence tracking what students do after opening it the first time is not possible. In addition, from the analysis it appeared that the amount of time students spend on an online platform is not a good indicator to determine engagement (students that are on a platform longer tend to be inactive). The experimentation took place in the more STEM (science, technology, engineering and math) related subjects; also, the staff working on the LA systems are related to the Faculty of Science (Faculteit der Natuurwetenschappen, Wiskunde en Informatica).

[43] See: http://www.educause.edu/library/academic-analytics

In Amsterdam and Derby, subsidy programmes (respectively from SURF and JISC[44]) were used to start the LA projects. Although these subsidies are rather modest, they created interest and momentum within the institution. A common key factor is that people from different disciplines are involved early on: IT specialists, faculty staff, administrators and decision makers. The institutional context of the organisations should enable these different stakeholders to cooperate. Even more, LA questions the existing organisational institutional structures as new and powerful alliances are made within the institution, crossing existing lines of hierarchy.

A necessary condition for the development of LA systems is the existence of 'early adopters' among the faculty: teachers that are willing to experiment with new ways of improving their course (increasing use of learning material, didactics, monitoring and evaluation). This is the case in both the Amsterdam case and the Purdue case. Finally, the students' perspective should be kept central in the project implementation: as LA concern their data, these should be primarily used for their benefit, i.e. to give them information about their progress in the course, or engagement with university life.

A3: Challenges and identification of the specific drivers behind the innovation initiative

The challenges that the initiative aims to address

The challenges LA systems aim to address are related to the massification of higher education and the related budgetary constraints. Massification causes academic staff to be less able to maintain close relationships with the student population and hence students lack insight in their progression in the course and engagement with the study and institute. Through the use of LA systems, institutes can develop a more learner-centred approach, which has been gradually decreased in times of massification. In addition, increasing the quality of provision (rethinking the instructional design of the course/programme) is an important challenge related to the use of LA.

Challenges posed by the massification of higher education and the consequent challenges in funding are closely inter-related in this initiative with changes in the supply of and demand for higher education, as the objectives of LA listed below show.

There are many different objectives attached to the use and development of LA systems, depending on the role the stakeholder has in the institution. The following objectives are mentioned in the three cases studied:

- Improving the monitoring of student progress, improving engagement of students with the learning / university life: expressed by administrators, teachers.

[44] http://www.jisc.ac.uk/

- Improving the quality of the course (seeing where students face difficulties): expressed by teachers.
- Increasing efficiency of teaching, reduce drop out: expressed by decision makers.
- Building stronger relationships between institutional data silos: expressed by IT staff.
- Generally, the objectives point in the same direction (i.e. improving knowledge about students' progression and engagement) and reinforce each other.

In relation to the Purdue initiative the challenges are expressed as follows: "Facing challenges of under prepared students, budget crises, decreasing retention and longer graduation periods, higher education is working to provide solutions to these challenges while at the same time balancing the demands of providing exceptional student service to foster student success. In an attempt to ease these mounting pressures, Course Signals was developed to help identify students potentially at risk of not reaching their full potential in a course. Once identified, instructors have the ability to deliver meaningful interventions suggesting behaviours students may wish to change in order to improve their chances of success."[45]

LA is primarily intended to respond to drop out rates of courses and to provide early warnings for students underperforming. Hereby, it helps to remove inefficiencies in the system (in the long run). This provides the HE institution a competitive advantage in relation to other institutions.

The immediate cause for developing the initiative

The immediate case for developing the initiatives stems mostly from an individual, or a small group of individuals interested in using the huge amount of data to improve the quality of services the HE institution delivers. In addition, top-down subsidy programmes help LA initiatives to emerge in a broader group of institutions and provides the opportunity to learn from experiments in other organisations. The precondition to the emergence of LA systems is of course the broad use of online learning management platforms and the availability of internet for students.

Part B: The higher education innovation system: functions, components and relationships

In part 2, the case will be studied along the lines of the higher education innovation system: functions, components and relationships.

[45] See: Arnold et al, 2012

B1: Analysis of the functions

The function to which the innovation is related

The function LA systems are related to the actual delivery and student-teacher interaction. There is a complaint that students, especially when entering university, are not accustomed to self-directed learning, perpetuated by a lack of personal interaction between student and teacher which they were familiar with in secondary education. Teachers do not have the time to get to know each student, let alone provide personal feedback on their progress made. This lack of interaction can result in a lack of engagement with learning, and insecurity on when students should start learning for their exams. LA systems can help student to acquaint themselves with university life and become better self-directed learners. In addition, teachers can use the data to monitor student progress and track where they have difficulties grasping the material.

In the more advanced systems (e.g. Purdue), the LA system is used to reflect on the course structure and quality. As expressed by a faculty member, professors tend to get a bit lazy when it comes to reflecting on the own course if they have been giving the course for years. The LA system provides systematic feedback on what can be improved and what is difficult for students to grasp. The LA can in that sense be seen as a lesson in pedagogy for academics: in many countries, university teachers have never been taught in pedagogy and didactics.

Impact of the innovation on other functions

The development of an LA system involves many sectors in the university: the IT department, teaching staff, policy makers, the student administration, the students themselves. Therefore, the LA system impacts on all these sectors:

- IT: Online learning platforms need to be adjusted to provide the required data. Data stored in different 'silos' need to be migrated.
- Teaching staff: using LA, impacts teaching, tutoring, course set-up and instructional design.
- Policy makers: LA works across departments and often does not respect hierarchical lines of governance. Hence it stimulates different groups within the university to cooperate. The governance model of the university needs to facilitate this.
- Student administration: Student administration needs to streamline information and make it (under strict conditions) available to the users of the LA systems. Hence they
- need to develop protocols for this.

B2: Analysis of the components

Identification and description of actors involved

Despite differences, similar actors are involved in the three cases: academic staff, IT departments, student administration, students, decision makers/policy makers, and funding councils (Derby and Amsterdam). Beside this, the initiatives show similarities as they are mostly bottom-up approaches, initiated by a small group of believers and early adopters. In Derby, the initiative came from the group involved in previous projects where a service design approach was implemented, putting the needs and demands of the student in the centre of developing effective student administration systems. In Amsterdam the work started in the beta faculty, where students and academics work on data-mining, developing algorithms etc. In Purdue, the work on the Course Signals initiated with the work of John Campbell and some academic staff members willing to test the first versions of the tool.

It should be mentioned, however, that different groups might have different intentions with the LA tool. This does not mean that these intentions run counter to each other. Increasing efficiency and effectiveness (decision makers) and raising quality of provision and tutoring (academic staff) can both be achieved with LA.

Implementation of the initiative

LA is an innovation that requires a long-term vision based on solid groundwork. To start, in each institute studied, there was a group of enthusiasts and early adopters that scoped out what data are needed for what purpose. In Amsterdam and Derby, the subsidy from the funding council (SURF and JISC) served as an encouragement. In all cases students were closely involved; not only as respondents of need-related questions, but also in the implementation of the projects (via internships). The table below provides an overview of the main actors involved in LA initiatives. A distinction is made with regard to the level at which these actors are active. Macro level is cross-university level; meso is cross faculty (university level) and micro level is related to individuals (or groups of individuals). In addition, the role and activity within the innovation is explained.

Table 15: Actors/stakeholders, level of operation, roles and responsibilities and activities

Actor 1	Level (macro, meso, micro)	Role/responsibility	Activity
Academic staff/tutoring	Micro	Responsible for the content of the tool	Applying the LA tool in their courses, delivering content, tutoring

IT support	Meso	Responsible for the linking of silos, development of the technical aspects and algorithms	Tool development, IT solutions
Student administration	Meso	Responsible for student data (background)	Linking data to other systems
(Faculty/ department) board/ decision makers	Meso	Responsible for the availability of funds/personnel	Providing support for the experimentation
Students	Micro	Using the tool, providing feedback on the tool	Using the LA tool, being involved in the development: providing a student perspective
Funding councils	Macro	Providing funds for experimentation at institute level	Developing and managing funding schemes and conducting additional activities (e.g. conferences, peer learning activities)

B3: Analysis of the relationships

The nature of the relationship

Experimentation and conducting the groundwork on LA systems requires the involvement of different groups within the institute. The initiative can be steered by different groups. For instance, in Purdue and Amsterdam the initiator was more related to the IT systems; in Derby, the project emerged from the student administration group. In general all groups (IT, academics, student administration, decision makers, and students) need to cooperate jointly in order to implement an LA system.

Changes in existing relationships

The development of LA systems does not change existing relationships, but it builds new relationships; for example, the creation of a relationship between academic staff and the IT departments, the IT departments and student administration.

Due to the involvement of the funding councils in the Netherlands and the UK, there is interaction between universities on LA. However, it should be emphasised that developing LA systems is a competitive advantage for universities, as they enable increased efficiency and effectiveness of the provision.

B4: Cross-elements analysis

Conclusions related to the innovation system[46]

What can be concluded from the analysis is that LA is based on a very bottom-up, collaborative innovation approach. Decision makers play multiple roles but often do not initiate the developments. The initiator often works at micro level (or, if in a broader group at meso level). Vertical lines of authority are basically absent, when organising the work in a LA working group, this group can operate fairly autonomously. When external funding is involved, some authority lies with the external organisation. Due to the collaborative nature of the initiative, each actor involved will be impacted in some way: it will affect the way matters are organised. For instance, the student administration will probably have to follow different procedures to prepare student data to be used in the tool. The student perspective is important, as the tool will finally have to affect their performance: hence students are included in the development as project assistants and they are involved to provide feedback.

Part C: Outcomes, assessment and conclusions

In part C outcomes will be assessed and conclusions will be drawn.

C1: Conclusions: Assessment of outcomes in terms of expected and unexpected consequences

Barriers and bottlenecks

The three initiatives studied are at different stages of development. Concerning barriers and bottlenecks, on the other hand, all initiatives had their share. The most important bottlenecks for establishing LA systems are listed below.

a. Institutional data and student data are stored in different 'silos' which do not communicate easily. Each department has its own data silo, online platforms store their data differently, administrative data are stored by central units and some data come from other sources.

b. The key question is not whether we have enough data, but what data are necessary to provide a risk profile of a student.

c. LA requires a team of people with different backgrounds. A bottleneck is that the stakeholders might have slightly different ideas and objectives, and communicate in a different language. In addition, initiatives cross hierarchical institutional structures.

d. Initiatives need individuals who believe in LA and early adopters among faculty staff. If these are absent, developments will not result in working systems. Convincing other faculty members remains difficult, even in advanced initiatives as at Purdue University.

[46] As there is no single model in the three cases, no innovation map is provided.

A reason for this is the implicit academic attitude that a course belongs to the professor and that external interference in the course structure and quality is avoided. Teachers using LA systems need to be trained, meaning that they need to be trained in being a teacher, willing to adapt the course to the specific needs of the students.

e. Although currently not leading to difficulties, an issue which is becoming more and more important is the ethical question related to big data. On the one hand, institutions are required to use data to offer the best possible education; on the other hand, privacy laws might forbid them in using and linking different data silos.[47]

Influence of the context on the success of the initiative

Contextual issues that play a role in the success of the initiative concern in the first place whether the institute (to some extent) embraces LA. Furthermore, regulations regarding data protection and privacy seem to be less of a barrier than anticipated. The current student generation is considered 'digital native' and students expect institutions to use data for the students' own benefit.

Outcomes and results

The outcomes of the three initiatives differ a lot. The SETL project in Derby was to increase the understanding of operational processes as well as to scope out the data requirements for a 'dashboard' of indicators which makes student engagement clear. It did not lead to a working system in the end. In Amsterdam, the team experimented with using data to visualise student activity and progression. They found out that available systems were not immediately available for making these visualisations and that close collaborations/migrations with the online platforms was needed to obtain the requested data. The results of CS in Purdue are most pronounced. Based on the recent article "Course Signals at Purdue: Using LA to Increase Student Success"[48], it can be concluded that students who participated in at least one Signal course are retained at rates significantly higher than their peers who had not attended any CS courses, but who started in the same semester (see table nr. 1). It should be added that the students who participated in the CS courses had, on average, lower standardised test scores than their peers. The analysis clearly indicates that following a CS course has an effect throughout the student career: when entering university students should be guided towards becoming self-directed learners. LA provides assistance in doing so, without increasing the number of tutor and study counsellors.

[47] See: Willis, James E., Campbell, John P., Pistilli, Matthew D. (2013), Ethics, Big Data, and Analysis: A Model for Application: May 6, 2013: http://www.educause.edu/ero/article/ethics-big-data-and-analytics-model-application; see as well on the ethical issues: Kay, D., Korn, N., Oppenheim, C. (2012), Legal, Risk and Ethical Aspects of Analytics in Higher Education, in: JISC CETIS Analytics Series: Volume 1, No. 6.

[48] Arnold, Kimberly E., Pistilli, Matthew D. (2012) Course Signals at Purdue: Using Learning Analytics to Increase Student Success: LAK'12, 29 April – 2 May 2012. In this article more results are presented on Course Signals.

Transferability

LA systems can be established in principle in every HE institution. There are no strict contextual factors that either stimulate, or hamper the development of a LA system. This means that the development of initiatives is based on rather random factors: individual initiative, faculty staff who are willing to experiment and availability of sufficient funds to start low-profile initiatives. The consequence is that there is no one roadmap for establishing an LA system.

In addition, it is considered unadvisable to transfer a working, turnkey system into another institution without conducting the groundwork on which indicators are useful. One of the most important features of a working LA system is that faculty and students deem it trustworthy. If the system itself cannot explain how and why it works, trust in the system evaporates and it is very difficult to regain.

To conclude, LA involves a large technical IT element. However, many respondents indicate that the technology is the 'enabler of change', not the innovation itself. The innovation lies in the **attitude of staff (and the HE institution) to put the student central to education provision**. This includes tracking where students stand in their learning progression, identification of those students at risk and tailoring the provision to the specific needs of students (when they encounter difficulties, additional tailored support should be provided). All in all, LA has the potential to further professionalise the teaching profession in HE.

Part D: Annexes

D1: List of literature used

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The US – originated MOOCs, with particular focus on the development of Coursera and its expansion to Europe

Author: Dr. Marina Ranga

Overview:

a. **Driver:** The globalisation processes with its weakening of national boundaries and increased competition among higher education institutions to recruit foreign students, made the MOOCs a learning model that attracted significant interest among higher education stakeholders; the changing supply of and demand for higher education: supply side developments include the possibility to use technology to provide new services and improve existing ones, whereas demand side developments include increased demand for LLL and home-based learning from both employees and employers.

b. **Strategy:** free online classes, development of technology and pedagogy for online education. The "MOOC initiative" primarily addresses education in higher education systems, especially the teaching, learning and curriculum development.

c. **Outcomes:** Mass Open Online Courses. New course formats: shorter, experiential, more interactive and more focused on skill acquisition; new methods of course assessment, and new forms of student interaction, free or at low cost, available to large numbers of students from all over the world; exploring new forms of learning and teaching, new ways of providing students with better skills for the ever changing needs of today's labour market.

d. **Key factors for success:** Stanford University's particular institutional set-up and close partnership with the university, availability of funding, collaboration and networking among HEIs and business corporations.

e. **Implementation challenges:** regulatory framework (IPRs, legal context to grant credit for MOOCs), MOOCs high attrition rate, recognition and accreditation, impact on the labour market, threat of firing professors, the competitive bidding process usually required for public higher institutions purchasing goods and services from private vendors, better understanding of the different kinds of MOOC students worldwide, rise of the 'star professor' and increasing competition among universities to recruit such star professors.

f. **Main changes:** the public perception of online higher education shifted from down-market for-profit colleges to the most famous universities in the world, fiercer competition among higher education institutions, students can choose courses more freely and learn according to their individual needs and circumstances.

g. Results:

- MOOC outcomes examined from five distinct perspectives: students; partners; course range and language; course format and principles and pedagogy, assessment, and accreditation.
- MOOC funding: primarily venture capital, complemented with smaller amounts from other institutions, like universities and international agencies, and individual entrepreneurs. Additional revenue from paid services that are offered to students in addition to the free courses, but these revenues are proportionally much less significant. None of the three companies has a well-established business model and profit-making strategies, as they are currently experimenting with several monetisation strategies, such as: the Signature Track and Career Services (Coursera), optional certified exams and referral fees (Udacity) and charging students for the statements of accomplishment (NovoEd).
- Transferability for Europe is examined in terms of the conditions for competition and collaboration between the US and European MOOC providers, e.g. the 18-month or more delay of European platform providers, different financial conditions for the support of MOOC providers in Europe, IPRs or state financial aid for students.

Part A: Setting the scene: introduction, challenges and contexts

A1: Introduction / definition of the innovation initiative

Overall objectives of the initiative and future plans

Coursera, Udacity and NovoEd are venture capital-backed education companies spun off from Stanford University. All are very young companies (Udacity was launched in January 2012, Coursera in April 2012 and NovoED in April 2013) and are founded by Stanford professors. All companies have a close connection with Stanford and the entrepreneurial and venture capital community of Silicon Valley, which had a key role in their creation and dynamic growth. The companies share a common belief in their role to bring accessible, affordable, engaging, and effective higher education to the world, but differ in their approach to realising this objective (see further details in Annex D3 - section 1 'Background information').

Outcomes of the practice

The outcomes of the practice are summarised in the table below from five distinct perspectives: **students; partners; course range and language; course format and principles; and pedagogy, assessment, and accreditation**. For further details on key features of each MOOC provider in relation to the perspectives see Annex D3 - section 2 'Outcomes of the initiative'.

Funding of the initiative

For all the three MOOC providers, venture capital has been the key funding source, complemented by smaller amounts from other institutions, like universities and international agencies, and individual entrepreneurs (see further details in Annex D3 - section 3 - 'Funding').

In addition to the external funding, all three MOOC providers get some additional revenue from paid services that are offered to students in addition to the free courses, but these revenues are proportionally much less significant. None of the three companies has a well-established business model and profit-making strategies, as they are currently experimenting with several monetisation strategies, such as: the Signature Track and Career Services (Coursera), optional certified exams and referral fees (Udacity) and charging students for the statements of accomplishment (NovoEd).

	Students	Partners	Course range and language	Course format	Pedagogy	Accreditation	Assessment
Coursera	Approx. 4.2 million (July 2013) from 196 countries (US 38.5%) Profile: general public	4 initial partners (Princeton, Stanford, University of Michigan and University of Pennsylvania); 83 current partners; Main focus on universities	Over 400 topics in a wide range of disciplines. Most courses in English, user-generated translations in Chinese, French, Spanish and Italian, Arabic, Portuguese, Russian	Interactive	Mastery learning	Statement of Accomplishment Accreditation by ACE CREDIT®) - 5 MOOCs approved for "credit equivalency"	Peer assessment
Udacity	750,000 from 203 countries (US 42%) India (7%), Britain (5%), Germany (4%) Profile: high school students, college students, professionals	No. Partners not available; Focus on universities and major business corporations	Fewer courses than Coursera, fewer disciplines. Main focus on computer science and related fields. Closed captions in English, subtitles in Spanish, Chinese, French, Portuguese, Croatian	Interactive, all courses focused on "open enrolment and learning by doing	Mastery learning	Certificate of Completion Accreditation by ACE CREDIT®) - 4 MOOCs still under evaluation by ACE	Peer assessment

NovoEd (formerly Venture Lab)	170,000 (April 2013) Profile: general public	n. a.	7 courses in entrepreneurship, business and innovation management; 10 private courses available only to Stanford students; Courses taught in English, Spanish recently introduced	Highly interactive, focus on teamwork and a creation of a social incentive system and reputation system to keep students on track and reduce the high attrition rates	Peer learning	Statement of Accomplishm ent	Peer assessmen t

A2: Understanding of the context

The context in which the practice is developed

Institutional context

The successful evolution of all the three MOOC providers has been strongly driven and supported by the particular institutional set-up of Stanford University and the close partnership with the University. Stanford MOOCs are on all three platforms and the university holds the copyright on all MOOCs that it offers.

Stanford University has a strong institutional context for online learning that is far from new. It can be traced back to 1969, when the Stanford Instructional Network (now the Stanford Centre for Professional Development) began broadcasting 12 Stanford Engineering graduate courses on two television microwave channels to students off campus. In 1990, the first computer-based Advanced Placement course was launched, and in1996, **Stanford Online** was introduced, as the first university internet system incorporating text, graphics, audio and video. A few other initiatives followed in 2005 – **Stanford's public site on Apple's iTunes U**, in 2006 – **Stanford Engineering Everywhere**, one of the first free sites to offer complete video-based courses and materials available on demand, starting with 10 free computer science and electrical engineering courses, and in 2006 – the **Stanford Online High School**, which is a complete, diploma granting service[49].

A new age for Stanford's online courses started in August 2011, after the huge success of three inaugural Computer Science courses taught by Stanford Engineering professors – 'Introduction to Artificial Intelligence' (Sebastian Thrun and Peter Norvig), 'Introduction to Databases' (Jennifer Widom) and 'Machine Learning' (Andrew Ng). In March 2012, the university launched five free online classes in an ongoing experiment to leverage new educational technologies, and in June 2012 Stanford awarded full funding for 12 faculty projects through the **Innovation in Online and Blended Teaching seed grant programme**, with partial funding for five additional faculty projects, and equipment and services offered to the remaining 23 proposed projects. In August 2012, a new **Vice Provost for Online Learning** was appointed, and **the Office of the Vice Provost for Online Learning** was created, with groups addressing pedagogy, production, and platforms to support online learning initiatives[50]. The Office of the Vice Provost for Online Learning provides support for pedagogy, content production, and web delivery. Stanford faculty or staff interested in offering a public online course must register their interest at http://bit.ly/StanfordFacOnlineCourse at least two months in advance of a potential launch

[49] See http://online.stanford.edu/programs for details about these programmes.
[50] See http://online.stanford.edu/about/history.

date. Normally, public courses will be launched once per quarter, subject to various considerations. Faculty developing online courses will be asked to sign a Course Development Agreement (CDA) and should allow enough lead time to work out copyright, accessibility, and other issues[51]. Other online learning-related programmes[52] include: Stanford on YouTube, Stanford Centre for Professional Development, Education's Digital Future in Stanford School of Education, Stanford Medicine Interactive Learning Initiatives (SMILI) and Stanford eCorner.

Regulatory context

At this early stage in the evolution of MOOCS, the regulatory context is still undefined in many respects. However, some controversial issues have started to emerge, particularly in relation to intellectual property rights (IPRs) and the competitive bidding process usually required for public higher institutions purchasing goods and services from private vendors. Also, a specific legal context for granting credit to MOOCs is starting to take shape in California, Florida and other states. These three issues are briefly discussed below:

- IPRs and collective bargaining agreements concluded between the university and faculty could be undermined by the professors delivering MOOCs

In traditional classes, IPRs belong either to the university professors who create the teaching materials, and therefore own them, or to the university, which owns the teaching material and can license it to the professor. In other cases, a "fair use exemption" allows a professor to use copyrighted work without securing permission from the holder. In the case of MOOCs, this exemption does not extend to the professors due to the courses' size, geographic reach, and (in some cases) for-profit nature, therefore "professors teaching MOOCs should ensure that the materials they distribute are theirs, in the public domain, or appropriately licensed for distribution," says Amanda Marie Baer, an attorney specialised in higher education (Sheridan, 2013).

Course and material ownership vary according to agreements made between the institution and the MOOC platform providers, and are neutral, in the sense of not interfering with ownership interests of professors or universities. However, the agreements between the university and faculty have been considered in some circumstances to have changed the terms of faculty employment, after some professors agreed to teach MOOCs. Relevant in this respect is the experience of the University of California at Santa Cruz, where the faculty union intended to seek a new round of collective bargaining after the introduction of MOOCs. In turn,

[51] See details on each of these programmes on http://online.stanford.edu/resources.
[52] See details on each of these programmes on http://online.stanford.edu/programs.

Santa Cruz's senior labour relations administrator argued that the professors' agreements to turn over their IPRs were "strictly voluntary" and should not force collective bargaining[53].

The discussion was triggered at Santa Cruz by the fact that this is the only UC campus to have a unionised tenure-track faculty, but in substance, the case is relevant to many other universities. Officials like the President of the University Council-American Federation of Teachers, which represents 4,000 University of California instructors and librarians, pointed out MOOCs' implications for shared governance and public funding on a systematic or structural level, beyond the individual benefits of the professors who are signing up to teach free classes: "*California has become a sort of ground zero for the colliding orbits of traditional campuses and outside companies*".[54]

Other IPR issues concern MOOC learners, who will likely be unable to claim the work they produce, because they don't pay tuition or receive credit. Therefore they are more often considered "users" than "students," and it is currently unclear whether they can have student ownership privileges. Other laws that apply to traditional students but may not extend to MOOC learners refer to whether or not MOOCs must be accessible to disabled individuals and whether they must refrain from discriminating against protected classes. These concerns stem from the free nature of MOOCs. Because they don't require federal financial aid, MOOCs may avoid the federal and state laws and regulations associated with federal financial aid – laws that apply to most college students (Sheridan, 2013).

- Signing of partnership agreements between public colleges and MOOC providers without going through a competitive bidding process

According to a recent Inside Higher Ed investigation (Rivers, 2013), such no-bid deals appear to have been made by at least 21 universities and higher education systems in 16 states that have signed agreements with Coursera, Udacity or edX. The absence of a competitive bidding process was justified on various grounds, such as little or no upfront costs for universities in almost all of the agreements, non-exclusivity, being concluded with sole providers, given the specificity of MOOCs to their respective companies. Other reasons also referred to the university's intention to simply experiment with MOOC technology, rather than planning to make money from the arrangements, and the similarity of the MOOCs services provided through these agreements to those of learning management systems (LMS), provided by various companies and non-profits usually awarded through with public procurement contracts[55]. Nevertheless, the argument of initial low-cost or no-cost terms of the partnership

[53] See details on http://edf.stanford.edu/readings/who-owns-mooc, March 20th, 2013.
[54] Ibid.
[55] For example, the University of California, Irvine argued that "the work with Coursera is an extension of the university's work with open educational resources, which involves the distribution of course materials through other online venues, including YouTube, iTunes U, Merlot and Connexions." The University of Tennessee said they signed the deals with MOOC providers just to get a taste of the

agreement as a rationale for avoiding a public bidding process holds little relevance, as MOOC providers like Coursera and Udacity, as private, for-profit companies funded by private venture capital, have nascent business models that demand outright payments, so that the issue of competitive bidding becomes important for public institutions that make technology deals with them (ibid).

- Legal provisions to grant credit for MOOCs

In March 2013, California Democrat State Senator Darrell Steinberg proposed **Senate Bill 520,** which would require the state's 145 public colleges and universities from the three state systems (University of California, California State University, and the community colleges), to grant credit to students who, unable to register for core classes at their home universities due to "bottleneck" conditions at the entry level, could take approved MOOCs offered by providers outside the state's higher-education system, including Coursera, Udacity, etc. If the bill is passed by the Legislature and signed into law by Gov. Jerry Brown, also a Democrat, state colleges and universities could be compelled to accept credits earned in MOOCs, accelerating the access of MOOCs to the mainstream (Gardner and Young, 2013).

The law aims to reduce the student dropout rate through an unprecedented partnership between traditional public colleges and MOOCS providers, but the implementation details are still to be defined, and their implications are vast. Key questions that are being raised refer to who will approve the courses, what role will faculty members have, whether student financial aid will apply to paid online courses, how will the revenue collected by the companies benefit the colleges, or whether the MOOCS will become "a substitution for campus-based instruction". In addition, there is a concern this top-down move may affect the university's leading role in driving the MOOCs' development and that MOOCS delivered online at very low cost may reduce the rigour of a traditional class. Another question is how MOOCs could fill the gaps of colleges' limited offer of courses that fails to meet student demand, and how access to fast internet connections for students can be ensured, when only about 66% of American adults have broadband access at home, according to a 2012 survey by the Pew Internet & American Life Project. The start-up cost of the platform is estimated to be about $10 million, roughly divided between public and private money (ibid.)

Senate Bill 520 has already raised criticism. Some see it as "*a top-down effort to allow private companies to profit from public institutions of higher learning—what some have approximately*

MOOC software or for other reasons that are unlikely to generate money. The University of New Mexico signed an agreement with Coursera which includes explicit revenue-sharing terms, but says that the university and the company do not have an agreed-upon monetisation strategy. The University of Washington has signed agreements with Coursera and edX, which were considered "merely a "marketing agreement" to allow the university to promote itself on the two platforms, but without money outcomes. Pennsylvania State University, the University of North Carolina at Chapel Hill and the University of Virginia have all signed agreements with Coursera but have no immediate plans to make money from the deal (Rivers, 2013).

119 the University of Phoenixization of the U Cal system. (...) The structure of SB 520 practically guarantees a cycle of demand and supply. ...As MOOCs attract more and more students with their theoretically unlimited capacity, pressures to preserve education funding for regular classes might diminish, which at the very least will sustain consistent demand for more MOOCs." (Busch, 2013)
Although unclear at the moment, there are direct implications of the bill for public universities nationwide, including the City University of New York (CUNY), which, like many public universities is under great financial stress and in tensions between administrators and faculty over curricular decision-making and control that could be potentially aggravated. The University of California Academic Senate issued a strong statement rejecting the proposed legislation, and CUNY faculty, in anticipation of the likely embrace of MOOC's by CUNY administrators, consider issuing a statement rejecting any possibility of MOOCs adoption at the university (Busch, 2013).

Nevertheless, California's example has inspired other states where similar legislation is now being proposed. For example, **Florida has passed a bill to encourage the state's K-12 and higher education systems to use MOOCs**. The bill allows MOOCs, under certain conditions, to be used to help teach K-12 students in four subjects, and also orders Florida education officials to study and set rules that would allow students who have yet to enrol in college to earn transfer credits by taking MOOCs. Due to fierce opposition from faculty, the law is narrower in scope than the original bill, which would have allowed anyone to create and seek "Florida-accredited" status for courses that the state's public colleges and universities would have to grant credit for. However, the scope of the law is expected to be expanded in coming months, as education officials set rules about the use of MOOCs for college credit. A major concern still remains that "a generation of "cheap and dirty" online courses can be offered to students before they enrol in college" (Inside Higher Ed, 2013).

A3: Challenges and identification of the specific drivers behind the innovation initiative

The challenges that the initiative aims to address

Challenges from the globalisation process

Globalisation has brought with it a weakening of national system boundaries, changing criteria of excellence, fiercer than ever competition among higher education institutions to recruit international students, imperative need to achieve global recognition for courses and qualifications and increased cross-border operations by using technology as a 'disruptive enabler'. MOOCs are the perfect expression of this 'disruptive enabler', by facilitating the enrolment of tens of thousands of students from all over the world and strengthening the competition between higher education institutions even further. The global recognition of MOOCs is still in its infancy, but steps in this direction are already being taken, with many universities starting to give credits for MOOCs.

The changing supply of and demand for higher education

These challenges come from 'supply-side' developments, which enable new services to be provided, as well as existing ones to be improved. It is evident from the facts described in the previous sections that MOOCs enable a multitude of new services to be provided, not only to students, but also to employers. Other challenges arise from the combination of new expectations and opportunities with the traditional structures and cultures of higher education institutions. Indeed, we have seen in the previous sections that MOOCs act as a major disruptive factor for the traditional structures and culture in universities and colleges, and in some cases they may lead to a renegotiation of the relationship between the university and faculty. Last, but not least, MOOCs also have a high potential to change the teaching and learning process, due to their high capacity to improve the learning process and the students' academic performance, give students more freedom and choice in the learning process, help them better understand their individual needs and circumstances, and ultimately increase the quality of their education.

On the demand side, challenges include changing needs of employers regarding the numbers and kinds of graduates, or changing needs in the development of workforce, with growing demands for lifelong learning and work-based learning. This is indeed one of the key issues for the future development of MOOCs. At the moment, it is too early to assess MOOCs' impact on the employers' needs and expectations, as many employers don't even know what MOOCs are. However, at the fast pace the MOOC phenomenon is evolving, their impact on the labour market will soon become more and more visible, and employers' acceptance of MOOCs outcome (be it a credited course or a statement of completion) is of major importance for the future shaping of the labour market. Other changes refer to the needs and expectations of students and their increasing diversity. For example, *students' financial circumstances* – will student financial aid granted by the state apply to MOOC learners?; employment *opportunities after graduation* – will they be enhanced by the completion of a MOOC?; *more study subjects and study methods* – will MOOCs be able to maintain high quality of education content, and will that complement or substitute on-campus education?

Challenges from changes in funding

Increasing education costs and declining public funding have created difficulties for many higher education institutions, particularly in recent years, in the context of the economic crisis. In the US, the cost of receiving a college degree has continued to grow, as student debt in the

US today has gone above $1 trillion, with the average debt per student standing at more than $25,000 (Empson, 2012). However, if government funding for public education has declined in many countries, in turn, *private investors now seem ready to provide education technology companies with the type of capital that has typically been reserved for consumer businesses.*

The issue of student fees is complex. Rising fees affect student demand and student mobility, where more students from high-fee countries may be tempted to cross borders into low- (or no-) fee countries. Also, different fee levels are introduced for different groups of students (national, international) and different fees are charged by different institutions or for different subjects. In some countries, private higher education providers offer low cost alternatives to public higher education and, in others, form an elite high cost and highly selective sector (ibid.). As MOOCs offer online education for free, with only some services being paid at relatively small costs, the fee issue is no longer a concern for students. MOOC providers continue to offer the courses for free, with only some services being paid at relatively low cost.

The immediate cause for developing the initiative

The immediate cause for developing the MOOCs by all the three platform providers was, as stated during the interviews, to provide *high quality education, free or at low cost, to large numbers of students from all over the world.* This makes a common denominator for all the three MOOC providers, although their individual approaches to realising this objective varies from one case to another. Beyond this objective, there is also a common desire to explore new forms of learning and teaching, new ways of providing students with better skills for the ever changing needs of today's labour market. New course formats, shorter, experiential, more interactive and more focused on skill acquisition, are being proposed, together with new methods of course assessment, like peer assessment, and new forms of student interaction, like peer learning.

Part B: The higher education innovation system: functions, components and relationships

B1: Analysis of the functions

The function to which the innovation is related

MOOCS address specifically the education function of the higher education system, and in particular the teaching and learning sub-functions (teaching based on mastery learning and peer learning, peer assessment, different course format than traditional on-campus courses, students learn at their own pace and receive immediate feedback) and curriculum development (combination between online and on-campus courses).

Impact of the innovation on other functions

There is only emerging evidence of a slight impact on the research function, in the sense of new research projects starting to be conducted to better understand the nature of MOOC learners and the dynamics of online learning. The impact of MOOCs on the "third mission" is only at the beginning, with start-ups like the three MOOC providers spinning-off Stanford University encouraging similar developments elsewhere.

B2: Analysis of the components

Identification and description of actors involved

Key actors who drove the development of MOOCs at Stanford are the professors who went on and created Coursera, Udacity and NovoEd companies that provide the respective MOOC platforms, but also the millions of students who enrolled for the MOOCs provided by these companies. MOOC development at these three companies is also strongly related to the institutional context at Stanford University, as explained previously. Beyond the university actors, there is also a broad community of stakeholders, including the local Silicon Valley venture capital firms that invested in the platform providers, other international sponsors, the vast network of national and international higher education partners, national regulatory agencies, etc.

Implementation of the initiative

A detailed description of stakeholders' role in the implementation of the initiative has been provided in the previous sections. Below is a summary of these roles:

Table 16: Actors/stakeholders, level of operation, roles and responsibilities and activities

Actor/stakeholder components	Level (macro, meso, micro)	Role/responsibility	Activity
Company stakeholders Stanford University Students	Micro and meso	▪ Institutional leaders; ▪ Mobilising resources ▪ Platform development ▪ Curriculum development; ▪ Teaching; ▪ Learning;	▪ Company management; ▪ Platform development; ▪ MOOC coordination and management by Stanford University (through Stanford Online) ▪ Allocation of university resources for MOOCs for the

			teaching assistants; ▪ Teaching; ▪ Learning;
External stakeholders: ▪ National and international partners ▪ National accreditation authorities ▪ Other higher education institutions, K-12 schools, etc. ▪ Private investors	Meso	▪ Partnership building ▪ MOOC accreditation ▪ VC investment	▪ Financial investment; ▪ Accreditation ▪ Student recruitment

B3: Analysis of the relationships

The nature of the relationship

The relationships between the different actors involved in MOOCs have been described in detail in the previous sections and summarised in the table above. MOOCs influence both the financial and non-financial dimensions of these relationships. From a financial standpoint, MOOCs have brought significant rounds of external VC investment in all the three platform providers and triggered the development of various internal monetisation strategies that are currently experimented in each company. The financial agreements with the partner universities also differ from one case to another. From a non-financial standpoint, one can note the collaboration between the platform providers and Stanford University, the collaboration within the company institutional teams, the fast progress made in partnering with a large number of universities around the world and the attraction of millions of learners from all over the world, etc.

Changes in existing relationships

Collaboration and networking are particularly intensified by MOOCs, as well as some forms of conflict between the new and old forms of teaching, learning, university-faculty relationships, university-external technology providers, IPRs, etc. Particularly relevant here is the rise of *the 'star professor' concept,* inspired by the huge success of Udacity's CEO Sebastian Thrun, who remained connected to Stanford only as research professor and teaches primarily through Udacity.

After the remarkable achievement of over 160,000 students enrolled in his first 'Introduction to Artificial Intelligence' MOOC in fall 2012, Thrun saw the vast potential of online courses to change not only the form and content of higher education, but also the relationship between the university and the top professors:

> *"Ever the disruptor, Thrun realised that he could make more money and enjoy greater freedom* outside *the university than within it. Moreover, his students would learn more if he could escape the "lecture trap," and develop online tools that generated greater interactivity, as well as quicker, more meaningful testing and feedback. As Thrun colorfully put it, "Having done this, I can't teach at Stanford again. I feel like there's a red pill and a blue pill, and you can take the blue pill and go back to your classroom and lecture your 20 students. But I've taken the red pill, and I've seen Wonderland."* (Crotty, 2012)

Thrun's example can potentially be replicated, at smaller or larger scale, by many other sought-after professors to whom a host of opportunities will open up, including separation from the home university and set-up of own start-ups, with a global audience and much higher revenues from public speaking, books, consulting, and referral fees to testing centers and credentialing sites. The possible consequences of such developments are vast and go well beyond the higher education sphere (see Crotty 2012 for a detailed discussion):

1. Bidding wars among the new slate of education technology startups to recruit star professors to their platform and lock them in to a long-term contract, with opt-out clauses and other caveats enabling a star professor to bolt a school or platform, if he or she really wants to.
2. A bifurcation of the tenure system and emergence of a two-tiered tenure system where the top tier will receive more than a guaranteed job, salary and benefits and will be able to lobby for special treatment, including profit sharing and residuals on global class enrollment and freedom to opt out of any of the quotidian busy work that comes with being a low- or mid-level professor.
3. Educational services will become a la carte, with specific costs for various types of educational services.
4. Enormous private capital investments in education tech companies that may fuel a new generation of bubbles with unpredictable consequences.
5. An increasing role of government as the largest buyer and purveyor of educational goods and services, as well as a major instigator of both outsized demand and lofty valuations.

6. The rise of a vast range of star support services, fan clubs, chat rooms, apps and games, a new market for paid endorsements by academic celebrities, ad hoc study groups, meet-ups organised via social media that will form around the classes of star professors, scouts, analysts, consultants, rankings, new brand values of the institution of the star professors and new opportunities for the top professorial talent to teach the globe's rich and famous for handsome fees.

Impact of the relationships on the innovative practice

Table 17: Relationships between actors

Actor 1	Actor 2	Relationship	What changed?
Students	Faculty	Teaching, assessment of academic work Learning	▪ Nature of the student-teacher interaction, ▪ Course format of courses ▪ Assessment of academic work (peer assessment), ▪ Student enrolment numbers increased dramatically ▪ Student graduation rates expected to increase too
(Star) professor	University	Teaching Departure from the home university to higher-ranking universities or set-up of own start-up	▪ Increased bargaining power for the 'star professor', ▪ Expected emergence of a two-tiered regime, with preferential treatment for 'star professors' ▪ Expected emergence of paid customised education services
MOOC provider company	International partners	Partnerships	▪ Rapid outreach to tens/hundreds of partner institutions around the world ▪ Partnership agreement between the MOOC provider and the institution not going through the public bidding process

B4: Cross-elements analysis

Conclusions related to the innovation system map

Taking into account the complexity of the "MOOC initiative", which includes a variety of institutional partners at different levels (especially micro and meso), we identify a mix of top-down and bottom-up approaches in the development and implementation of MOOCs. For example, both vertical and horizontal authority lines are at work within the platform providers, among the leadership team, the technical team and the advisory board. Also, the collaboration of the platform providers with Stanford University is an interesting mix of vertical and horizontal authority lines, as the company co-founders are Stanford professors, albeit on a leave of absence to focus on the company business, or only marginally related to Stanford like Sebastian Thrun. Horizontal relations between the platform providers, Stanford, various partners and investors involve collaboration, which has clear benefits that are spread over all the stakeholders, but also competition, especially among various platform providers and among universities, which is likely to induce dramatic changes in the higher education landscape in the next five-ten years.

Part C: Outcomes, assessment and conclusions

C1: Conclusions: Assessment of outcomes in terms of expected and unexpected consequences

Barriers and bottlenecks

The fast expansion of MOOCs since the end of 2011 has brought to the fore a number of issues that will require a lot of attention in the near future:

- *Regulatory context*, especially in terms of IPRs and legislation recognising the MOOCs value and encouraging higher education institutions to adopt them;
- *MOOC high attrition rate (approx. 85%)* – although that is high, it appears to be not significantly different from traditional higher education, as Stanford professor Keith Devlin remarks in a recent Huffington Post blog article (Devlin, 2013), and therefore, "applying the traditional metrics of higher education to MOOCs is entirely misleading. MOOCs are a very different kind of educational package, and they need different metrics – metrics that we do not yet know how to construct."
- *Accreditation* – some steps in the direction of giving credit for a selected set of Coursera and Udacity have been already taken and the first five Coursera MOOCs have been approved for credit. However, a large share of MOOC learners never complete a course and are not looking for credits, but only for education, and for them the need for accreditation is not an issue (Devlin, 2013). For students who are indeed looking for

accreditation, e.g. those paying $50 for Coursera's Signature Track programme, the pass rates are much higher, at about 70%, which is even higher than the non-Signature Track students who profess in surveys to high levels of commitment to completing the course, as noted by Daphne Koller (Kolowich, 2013).

- *Better understanding of* what different kinds of people sign up for MOOCS and what their goals are. This is an important factor for reducing the attrition rate. Recent MOOC-related research at Harvard University found that people who register for MOOCs include precocious high school students, college students looking for more ways to study a subject they are learning in a traditional classroom, faculty who want to watch how other faculty teach their subject, stay-at-home parents or retirees, etc. Another study of MOOC users led by MIT's Teaching and Learning Laboratory, and funded by NSF, based on data from edX's 2012 circuits and electronics found different dropout rates for different categories. Phil Hill, an education technology consultant, has come up with four categories of MOOC users: lurkers, drop-ins, passive participants and active participants (Rivard, 2013b).
- *Impact on the labour market* – too early to assess.

Influence of the context on the success of the initiative

The innovative environment and the strong institutional context for online learning of Stanford University, the vision, skills and dedication of the platform providers' institutional teams and the availability of Silicon Valley venture capital have been major success factors for the MOOCs.

Outcomes and results

Among the main measurable outcomes of MOOCs are student enrolment numbers, retention and graduation rates at different stages in the duration of a course, from pre-registration to completion, student demographics, etc. New statistics have started to be developed in order to better understanding the nature and behaviour of online learners[56]. Also, the rise of the 'star professor' and increasing competition among universities to recruit such star professors can also be mentioned as consequences of MOOC development. A dramatic reduction in the price of a traditional higher education is also expected, by many established universities expected to start soon offer credits towards their degrees for those who complete MOOCs (*The Economist*, 2013). No impact assessment of MOOCs has been carried so far, as the initiative is still very new.

[56] This type of data is monitored by the platform providers and is generally kept confidential due to the sensitivity to the personal data of the students.

There is a general feel that the higher education landscape is likely to change dramatically in the next five-ten years, as a result of the four challenges discussed previously (challenges from the globalisation process, from "users" and "consumers", from "within" and from changes in funding) and many other factors, and MOOCs are one of the key drivers of this change. Major transformations, or even disappearance, are expected in the physical configurations of classrooms, labs and campuses. Collaboration between higher education institutions is expected to increase, but even more so, the fierce competition between them, which may sometimes lead to the disappearance of some institutions. In order to better prepare for these challenges and increase their competitive advantage, more and more universities jump on the MOOC bandwagon and forge alliances with the emerging key players in this domain, such as Coursera, Udacity and NovoEd: "Status anxiety...is the great motivating force in elite higher education, and where elite colleges go, others follow. In a stroke, the public perception of online higher education shifted from down-market for-profit colleges to the most famous universities in the world" (Carey, 2012).

Transferability

MOOCs have known a rapid development in Europe and other parts of the world, with several companies developing their own platforms[57]. In some cases, these companies are university spin-offs, in other cases, they are independent IT providers. The 18-month or more delay of European platform providers can, in some cases, make the competition with the Stanford start-ups more difficult, in view of their first mover advantage. There is, however, ample space for competition, especially in terms of MOOC content, where Europe can make its mark, by providing courses delivered by top European professors and focusing on valuable European features like culture, arts, history, etc. The MOOC transferability to Europe is also highly influenced by the different financial conditions for the support of MOOC providers, where the significant role of VC funding has been replaced by foundations, national and regional government agencies, etc. Some controversial aspects related to the MOOC implementation, such as IPRs, adoption of MOOCs as a modality to save costs and the threat of firing professors, the rise of the 'star professor' or the applicability of state financial aid for MOOC students are not so visible in Europe yet, taking into account the earlier development stage here.

[57] See http://moocnewsandreviews.com/mooc-around-the-world-our-global-list-of-distance-education-resources-part-1/ for a list of MOOC providers in Europe and beyond.

Part D: Annexes

D1: List of literature used

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D2: List of contributors to the case study

Name	Organisation	Country
Andrew Ng	Professor, Director of the Stanford Artificial Intelligence Lab, Coursera Co-founder (teaches 'Machine Learning' MOOC), Stanford University	US
Daphne Koller	Professor, School of Engineering, Coursera Co-founder and CEO (teaches 'Probabilistic Graphical Models'), Stanford University	US
Clint Korver	Stanford Adjunct professor, School of Management Science & Engineering, Co-founder and partner of Ulu Ventures (Silicon Valley-based early stage venture firm), Co-founder and co-president of Stanford Angels and Entrepreneurs (Alumni Association with 300+ members that connects investors and entrepreneurs) (teaches 'The Ethical Analyst' and 'Startup Boards' MOOCs)Stanford University Ulu Ventures Stanford Angels & Entrepreneurs	US
Keith Devlin	Professor, Co-founder and Executive Director of H-	US

	STAR Institute, co-founder of the Stanford Media X (teaches 'Introduction to Mathematical Thinking' MOOC), Stanford University	
Chuck Eesley	Assistant Professor, School of Management Science & Engineering (teaches 'Technology Entrepreneurship' MOOC), Stanford University	US
Kay Giesecke	Associate Professor, School of Management Science & Engineering, (teaches 'Finance' MOOC), Stanford University	US
Farnaz Ronaghi	Stanford PhD student, Co-founder NovoEd, Stanford University NovoEd	US
Jonathan Kydd	Professor, Dean of University of London International Programmes, University of London	UK
Michael Kerrison	Director of Academic Development, University of London International Programmes, University of London	UK
Barney Grainger	Academic Project Manager, University of London International Programmes, University of London	UK
Jeff Haywood	Professor of Education & Technology, School of Education, Vice Principal Knowledge Management, Chief Information Officer & Librarian, University of Edinburgh, University of Edinburgh	UK
Other people contacted, no reply or declined		
Tina Seelig	Stanford Professor, School of Management Science & Engineering, and the Hasso Plattner Institute of Design at Stanford (d.school), Executive Director, Stanford Technology Ventures Program (teaches 'A Crash Course on Creativity' MOOC), Stanford University	US
John Mitchell	Vice Provost for Online Learning at Stanford, Stanford University	US
Bernd Girod	School Engineering, Senior Associate Dean for Online Learning and Professional Development, and Vice Provost for Online Learning, Stanford University	US
Sebastian Thrun	Stanford Research Professor, Udacity co-founder (teaches 'Programming a Robotic Car', 'Introduction to Statistics - Making Decisions based on Data', Introduction to Artificial Intelligence' MOOCs), Stanford University	US
Clarissa Shen	Udacity Vice-President of Strategic Business and Marketing(declined meeting for lack of capacity), Udacity	US
David Stavens	Udacity Co-founder, President (declined meeting for no longer being involved in Udacity), Udacity	US
Mike Sokolsky	*Udacity Co-Founder, CTO*, Udacity	US
Amin Saberi	Stanford Associate Professor, School of Management	US

	Science & Engineering, NovoEdCo-founder and CEO, Stanford University, NovoEd	

The interviews have been conducted in the period 29 May - 5 June 2013, face to face and by Skype (only one, with Clint Korver).

D3: Additional annexes (documentation, survey results, interview reports, etc.)

Background information

Coursera, Udacity and NovoEd are venture capital-backed education companies spun off from Stanford University. Udacity was launched in January 2012, co-founded by Stanford professor and Google Fellow Sebastian Thrun as CEO and two other top computer and robotics scientists. Coursera followed in April 2012 and was co-founded by Stanford professors Andrew Ng and Daphne Koller. NovoED came to life in April 2013, when co-founders Amin Saberi, Stanford professor, and PhD student Farnaz Ronaghi decided to re-brand and re-launch under the new name of NovoEd an earlier project called Venture Lab, which was started in March 2012.

Both Udacity and Coursera evolved out of the hugely popular Stanford free online classes that Andrew Ng and Sebastian Thrun (together with Peter Norvig) had taught as an experiment in fall 2011 on 'Machine Learning' and 'Introduction to Artificial Intelligence', respectively. Andrew Ng' s course had 104,000 people enrolled, with at least 46,000 completing at least one homework assignment, 23,000 of them completing a "substantial" amount of the class, and 13,000 receiving a "statement of accomplishment" (Gannes, 2012). Sebastian Thrun and Peter Norvig' s course attracted over 160,000 students from 190 countries and graduated 23,000, making MOOC history as the first online class to graduate more students in the field of AI than all other brick and mortar classes combined (Wired Academic, 2012). The key message of this hugely successful experiment was "not that there were so many people in the world that wanted to learn AI from top experts for free, and that there were so many people in the world who could complete such an advanced course from a top university, but the fact that many of the on-campus Stanford students stopped going to lectures. The students preferred the online version and those who participated online scored a whole grade better in both the midterm and final exam"58. The two Stanford professors saw the vast possibilities for expansion of this experiment and decided to explore the online courses further.

Udacity was born shortly after as a company with the mission to "bring accessible, affordable, engaging, and highly effective higher education to the world. We believe that higher education is a basic human right, and we seek to empower our students to advance their education and

[58] 'The Original, Free Online AI Class, now on Udacity!' Coursera blog, November 28, 2012. http://blog.udacity.com/2012/11/ai-class-now-on-udacity.html

careers"[59]. The company has a five-person leadership team headed by CEO Sebastian Thrun, who remained affiliated to Stanford as Research Professor, and an Advisory Board that includes top representatives of software corporations and policy-making authorities, academics, Silicon Valley entrepreneurial and venture capital communities.

Coursera shares a similar belief: "we believe in connecting people to a great education so that anyone around the world can learn without limits... We envision a future where everyone has access to a world-class education that has so far been available to a select few. We aim to empower people with education that will improve their lives, the lives of their families, and the communities they live in" [60]. This vision represents a merger of the perspectives on the higher education future of its two co-founders, Andrew Ng and Daphne Koller, who had worked for several years on developing technology and pedagogy for online education. Daphne Koller had initially focused on improving the educational experience for Stanford students, via the "flipped classroom" model[61], and Andrew Ng had initially focused on developing online courses that can be offered freely to anyone in the world. Both Andrew and Daphne are now on leave from Stanford in view of developing the platform and the company. Coursera's team[62] currently counts some 50 people specialised in engineering, design, course operations, business development, administration and staffing. The team is planned to expand to about 100 by the end of 2013, after the $43 million series B financing (see details in section A1 Funding of the Initiative), which will allow the company to develop new activities. Coursera also has an international Advisory Board, consisting of top leaders of several US and European elite universities[63].

NovoEd's precursor Venture Lab originated in co-founder Farnaz Ronaghi's PhD project focus on online education and team formation algorithms, which aimed to create a technology platform that would not only offer online courses for free, but would also create social links between team and enhances collaboration, project- and team-based learning. The focus on peer interaction for learning and team dynamics was a distinctive approach for Venture Lab from the start - none of the other existing platforms supported this objective. "Instead of putting the spotlight on the professors and pretending that they know all the answers, we put the spotlight on the students and help them unleash their own power," said Amin Saberi, director of Venture Lab and CEO of NovoEd (Najarro, 2013). The Venture Lab platform offered four courses in fall 2012. The first of them was the "Technology and Entrepreneurship" class of Stanford assistant professor of management science and engineering Chuck Eesley, whose

[59] https://www.udacity.com/us#sec3
[60] *Coursera Overview*, document provided by Daphne Koller.
[61] This is a relatively new educational concept that aims to revert to the traditional teaching methods, delivering instruction online outside of class and moving homework into the classroom. See further details at http://www.knewton.com/flipped-classroom/.
[62] See structure of the team at https://www.coursera.org/#about/team
[63] See structure of the Advisory Board at https://www.coursera.org/#about/founders

conversations with Amin Saberi actually originated the concept for Venture Lab. Chuck's wish to make his originally videotaped class more accessible to a global audience through the online format became a full-time job for Saberi. When it became available on the Venture Lab platform, in mid-April 2012 Chuck's course attracted around 80,000 students from over 150 countries, out of which 40,000 students worked on their start up projects. In October 2012, Venture Lab added four new courses from Stanford faculty, bringing the total number to five[64].

In April 2013, Venture Lab was re-branded and re-launched as NovoEd, keeping the same major focus on peer learning in smaller groups, which was proven to be more effective in retaining students in creative disciplines than the mastery learning lecture-based MOOCs in math or computer science. This focus is central to NovoEd's mission and the way the company presents itself, as**: "**the only online learning platform that provides a connected, effective and engaging learning environment for students using a combination of techniques in crowd sourcing, design and analysis of reputation systems, and algorithm design. NovoEd's philosophy is to advance the online learning experience by making online courses more experiential, interactive, and collaborative"[65]. The company has a small six-person team headed by Amin Saberi, co-founder and CEO. Both Amin Saberi and Farnaz Ronaghi took a leave of absence as of January 1, 2013, to pursue NovoEd full time.

Outcomes of the initiative

Students

In terms of students, **Coursera** is by far the most advanced. Coursera students ("courserians") reached approx. 4.2 million by the end of July 2013 and their number is increasing rapidly[66]. According to August 2012 statistics, students came from 196 countries, with the US accounting for 38.5% of the overall enrolment. Other prominent countries included India, Brazil, China, Canada, UK, Russia, Germany, Spain and Australia[67]. The company's top 20 list also Colombia, Ukraine and Thailand. Coursera student concentrations are also visible at the level of specific metro areas worldwide, e.g. local student communities are clustered in 433 cities and aim to create periodic meet-ups so participants can mingle. The three largest such groups are in the US with at least 90 students apiece in Stanford, San Francisco and New York, and the rest of the top-10 list includes Bangalore, London, Moscow, Sao Paolo and Mumbai (Anders, 2012).

[64] http://www.blog.class-central.com/stanford-novoed-mooc/
[65] http://novoed.com/
[66] See the counter of Coursera students with the latest update at https://www.coursera.org/.
[67] 'Coursera hits 1 million students across 196 countries', Coursera blog. http://blog.coursera.org/post/29062736760/coursera-hits-1-million-students-across-196-countries.

Udacity students ("udacians") count over 750,000 and come from 203 countries, according to summer 2012 statistics, with the greatest number of students in the US (42%), India (7%), Britain (5%), and Germany (4%) (Young, 2012)

NovoEd students added to the over 170,000 people taking Venture Lab courses by April 2013[68].

Partners

In terms of partners, **Coursera** is again topping the list. Since its April 2012 launch with four university partners (Princeton, Stanford, University of Michigan and University of Pennsylvania), the company partnerships have grown at a rapid pace. It currently counts 83 universities and other institutions among its partners worldwide (see all partners at https://www.coursera.org/#partners). *A distinctive mark in terms of the partners' profile is Coursera's focus primarily on top-tier higher education institutions from the US and internationally.*

Among the most recent partners are:

- **A group of 10 US state university systems and public schools**[69] committed to using MOOC technology and content to improve completion, quality and access to higher education, both across the schools' combined audiences of approximately 1.25 million students and among Coursera' s over four million global learners. The novelty of the partnership is that these institutions intend to do more than just joining to bring their own content online for the general population; *they will add MOOC to their own courses and collaborate on existing content,* reaping the benefits of MOOC-based content in their own classrooms and on their own campuses. The new education approach will be implemented in pilot programmes, which will be evaluated based on their effectiveness in enhancing student success. The new approach has multiple benefits, including encouraging new learning methods, strengthening combined on-campus and online teaching, improving existing "blended learning," which combines online video lectures and content with active, in-person classroom interactions, using Coursera's data analytics by professors and universities to identify learning obstacles and recognize gaps in subject matter. From a broader perspective, the new approach is expected to further strengthen the links between MOOCs and mainstream institutions, expand the community of excellent educators providing MOOCs to the world, and open

[68] http://www.blog.class-central.com/stanford-novoed-mooc/

[69] The State University of New York (SUNY), Tennessee Board of Regent, University of Tennessee System, University of Colorado System, University of Houston System, University of Kentucky, University of Nebraska, University of New Mexico, University System of Georgia, West Virginia University. http://blog.coursera.org/post/51696469860/10-us-state-university-systems-and-public-institutions.

up new channels for sharing knowledge and resources between professors, across campuses, and among entire state university systems (Protalinksi, 2013).

- **The University of Chicago**, which will offer an initial two courses in science and business;
- **Technion-Israel Institute of Technology and Tel Aviv University (TAU),** which will offer an initial four courses in engineering, archaeology, biology and cultural studies, with Technion's first course being offered in English and Arabic[70].
- **The University of Hong Kong,** which will offer five Chinese courses. The expansion towards more Chinese universities is of high interest to Coursera, so that they can bring their courses online and reach more students[71].
- **The University of London,** which will offer an initial five courses starting in spring 2014.
- **The University of Edinburgh** is also developing courses with Coursera. Both universities emphasised that their interest in collaborating with Coursera was primarily a strategic business decision to be involved in broader developments in the higher education sector, and to maintain their reputation as serious contenders on a larger scale.

Udacity partnerships (exact number not available) focus on universities as well, but to a lesser extent than Coursera, and also on major business corporations, in pursuit of their objective to provide students with better skills for meeting current employment needs: "We are reinventing education for the 21st century by bridging the gap between real-world skills, relevant education, and employment". *This specific focus on new skills for better employment opportunities makes a distinctive mark for Udacity.* Below are some of Udacity's key partners:

- **San Jose State University (SJSU),** with whom Udacity has developed a pilot programme called *San Jose State University Plus*. The pilot, which began in January 2013, combined the knowledge and expertise of SJSU faculty with Udacity's online platform and pedagogy to provide three remedial courses (two in math and one in statistics) to SJSU and non-SJSU students, at the affordable price of $150 per course, similar to a course at the California community colleges. The pilot's target population included underserved groups such as high school students who will earn college credit, waitlisted students at California community colleges who would otherwise face out-of-state or private options, and members of the armed forces and veterans. Course

[70] See details on http://blog.coursera.org/
[71] Interview with Daphne Koller: Online education platform Coursera aims to reach more Chinese. 7 June 2013. http://news.xinhuanet.com/english/indepth/2013-06/07/c_132436533.htm

assessment is supported by funding from the National Science Foundation (*Business Wire*, 2013).

On 19 July 2013, the pilot was put "on hold" because of very low pass rates, ranging between 20% to 51%, much lower than the average 75% pass rates at SJSU's on-campus courses. Causes for the failure related primarily to: (i) rapid assembly of course material, with little time for testing and fine-tuning each lesson, (ii) pitching classes to a very different population than the usual SJSU traditional class, with high-risk students (about 20% of enrolment consisted of high-school students, while many others were college-age students who had failed earlier math classes), and (iii) lack of reliable access to internet for some students, making it hard for them to do all the necessary work (Anders, 2013a). The failure was considered by Udacity as an opportunity to innovate around the pacing and duration of the classes, given the non-traditional student population. Nevertheless, the course was also seen as a success for having reached a much broader student population than what could be usually found on any college campus, for giving students who had struggled with remedial algebra another chance to succeed, and for greatly increasing the retention rate (about 83%, in contrast to the 5%-10% range in traditional MOOCs), mainly due to course support services (Thrun, 2013)[72].

- **Georgia Tech and AT&T** are two key business partners for Udacity. In May 2013, Georgia Institute of Technology College of Computing announced it will offer *the first professional Online MSc degree in Computer Science (OMS CS) that can be earned completely through the "massive online" format.* The degree will be provided in collaboration with Udacity Inc. and AT&T, with enhanced support services for students and at a tuition fee of $6,630 - a fraction of the cost of traditional on-campus Master's programmes. Initial enrolment will be limited to a few hundred students from AT&T and Georgia Tech corporate affiliates, and is expected to gradually expand to 10,000 students over the next three years. The pilot programme is heavily subsidised by a $2 million gift from AT&T and will begin in the next academic year (PRNewswire, 2013, Rivard, 2013a).

The low-cost online Master's degree is an important novelty in that *it creates what may be a first-of-its-kind template for the evolving role of public universities and corporations and will allow one of the country's top computer science programmes to enrol 20 times as many students as it does now in its online master's degree programme at a sixth of the price of its existing program* (Rivard, 2013a). Recent details provided by Inside Higher Ed about the Udacity-Georgia Tech agreement reveal that it includes very precise provisions about the student-staff interaction, the payment of professors who create new online courses with

[72] See details on http://blog.udacity.com/2013/07/sebastian-thrun-improving-our-for.html.

$30,000 or more, and creation of two new categories of educators - Georgia Tech corporate "course assistants" tasked with handling student issues, and a corps of Udacity teaching assistants hired by Georgia Tech who will be professionals rather than graduate students. This last provision raised concern about the role of professors, in spite of assurances of Georgia Tech's dean that professors will remain in charge of their courses (Rivard, 2013a).

- **Google, NVIDIA, Microsoft, Autodesk, Cadence and Wolfram** are another group of business partners with whom Udacity teamed up to deliver a new series of free online courses, from HTML5 Game Development and 3D Graphics Programming to Mobile App Development. Additionally, computational tools from Wolfram, makers of Mathematica and Wolfram|Alpha, will be integrated into upcoming Udacity course offerings to enhance the student learning experience (Business Wire 2012). *The partnership is particularly important for showing a significant sponsorship of major corporations in the development of new MOOCs that have a high potential to connect university education with workforce education ...and advance both education and career opportunities for students*, as Sebastian Thrun, Udacity Ceo pointed out (ibid.).

Very little information is available about **NovoEd** partners, which is to some extent understandable, given the short time since the company's launch in April 2013. Universities are a primary target for the company (Empson, 2013a). A partnership with the Latin-American University, Pontifical Catholic University of Chile, was announced in June 2013 (*Business Wire*, 2013a).

Course range and language

In terms of courses, **Coursera** is again at the top of the range, with over 400 courses currently offered (see all courses at https://www.coursera.org/#courses) that cover a wide range of topics, spanning the Humanities, Medicine, Biology, Social Sciences, Mathematics, Business, Computer Science, and many others. Some of the most popular courses include '*Think Again: How to Reason and Argue*' by Duke University, with 180,000 people signed up, and '*Introduction to Finance'* by Michigan University, with 125,000 signed up[73]. The majority of courses are offered in English, but in many cases, user-generated translations in a number of languages are also available, such as Chinese, French, Spanish and Italian. A Global Translation Partners Programme was set up at Coursera, in partnership with a host of translation companies and a variety of organisations to provide more language choices such as Arabic, Portuguese and Russian. "We hope to partner with organizations based in China to create captions for our most popular courses in China, such as Introduction to Finance and

[73] Interview with Daphne Koller, CEO of Coursera by **Elena Masolova, EDUSON co-founder, on** April 1st 2013. https://www.eduson.tv/blog/coursera.

Machine Learning", said Daphne Koller in a recent interview[74]. Andrew Ng, Coursera-co-founder sees this expansion as progress towards the company's mission to extend access to higher education learning as broadly as possible: "Though most of our students today are fluent English speakers, most of the world is not" (Palin, 2013).

Udacity courses have a narrower scope than Coursera's, and cover Business, Biology, Computer Science, Mathematics, Physics and Psychology. *Udacity intends to remain focused on computer science and related fields, and not go into humanities,* according to Sebastian Thrun (cited in Young, 2012). Courses are offered at Beginner, Intermediate and Advanced levels, and target high school students (offering options to earn college credit and take subjects not offered at their school), college students (offering access to lower cost and high quality college courses, with options for college credit and courses not offered at their school), and professionals (offering possibilities to update skills or shift careers with up-to-date courses from prestigious teachers). All Udacity courses are closed captioned in English, and many of them have subtitles available in many different languages, including Spanish, Chinese, French, Portuguese, and Croatian. In most cases, Udacity classes are always available once they have launched and have no deadlines, so that students can take them at their own pace. Students can enrol in several classes.

Novoed offers access to seven Stanford courses to the general public, focused particularly on entrepreneurship, business and innovation management (see http://novoed.com/), as well as 10 private courses available only to current Stanford students. *The focus on entrepreneurship and technology management makes a distinctive feature of NovoEd in contrast with other MOOCs services that focus on mastery learning, like computer science and math.* NovoEd courses are taught in English, but in June 2013, the first NovoEd MOOC offered exclusively in Spanish became available, being offered by Stanford PhD, Pontifical Catholic University of Chile professor and strategic decision expert, Patricio del Sol. This is a five-week free course that will teach students key principles of strategic choices in the business landscape. The course features creative class work and engaging video filmed on location in Silicon Valley, and is available to any Spanish speaking person with an Internet connection (Business Wire, 2013a).

Course format

Coursera MOOCs, in contrast to earlier distance-learning efforts centred on the "taped lecture", combine active learning and interactive engagement between faculty and students, and between students and their peers, which have been proven to be more effective than traditional lectures (Deslauriers, Schelew and Wieman, 2011). The platform makes it possible to move much of the traditional lecturing from inside to outside the classroom, in an online

[74] Interview: Online education platform Coursera aims to reach more Chinese. 7 June 2013. http://news.xinhuanet.com/english/indepth/2013-06/07/c_132436533.htm

learning format that is more interactive and more engaging. The courses make heavy use of interactive exercises that use Web 2.0 tools, videos and snap quizzes with instant online grading that typically break up instructors' material every few minutes and ask the students to answer a simple question to test whether they are tracking the material and whether they understand key concepts. Partner institutions offer hybrid courses, which involve both online and face-to-face learning, which are considered to be considerably more effective than either method alone (US Department of Education, 2010). Personalisation on several levels is present in each course, in a bid to keep students engaged, even though an individual MOOC may attract 100,000 or more students worldwide. The students are also involved in various online forums and chat groups with their peers between formal sessions[75].

Udacity MOOCs are also highly interactive. They consist of several units comprising video lectures with closed captioning, talks by instructors and industry experts, and integrated quizzes and exercises to help students understand concepts and reinforce ideas, as well as follow-up homework that promotes a "learning by doing" model. The videos and quizzes can be re-taken any time. Lessons are usually followed by a problem set with exercises that count towards mastery level. Since August 2012, all courses have been "open enrolment", i.e. students can enrol in one or more courses at any time after a course is launched. All course lectures and problem sets are available upon enrolment and can then be completed at the student's preferred pace. Each course unit is designed to provide a week's worth of instruction and homework. No textbooks are required for Udacity courses.

NovoEd MOOCS are also highly interactive and are designed specifically with teamwork in mind. After signing up for the course, the students are assigned to groups of 10 or fewer peers, based on their location or similar interests and backgrounds. Courses offer a video lecture, at the end of which there is a challenge for the team. Student communication during the class can take place by messaging one another or in discussion boards under an assignment. Students can evaluate their peers' performance, much like team projects in face-to-face lecture courses, and the rankings are compiled at the end of the course to form a student's "Team Score," which shows how good a team or a team player are. On this basis, student can make decisions when they're later allowed to form groups on their own.

The highly interactive learning process created in NovoEd courses aims to create a social incentive system that aims to keep students on track reduce the high attrition rates specific to MOOCs (Empson, 2013a). In this spirit, NovoEd platform designers aim to understand better what incentives motivate high quality reviews and incentivise good behaviour. NovoEd courses attach importance to *reputation systems*, where the helpfulness of the review, the evaluation of team work and self-evaluation are central. In this spirit, *a 'Hall of Fame'* has been

[75] See details on https://www.coursera.org/#about/pedagogy.

introduced, which features students whose reputation has increased. Similarly, *'Star Reviewers'* are rewarded for the quality of their reviews. The ultimate objective is to create a dynamic in which students are accountable to their peers, and feel social pressure to perform to keep their rankings up, creating an experience that's more engaging.

Pedagogy

Both **Coursera and Udacity** MOOCs are based on the principle of *mastery learning*, which aims to help students learn the material quickly and effectively, giving them multiple opportunities to demonstrate their knowledge, learn at their own pace, test their knowledge, receive immediate feedback on concepts that have not been understood, reinforce concepts through interactive exercises, monitor their own progress and know when they really mastered the material. Mastery Learning was shown to increase student performance by about one standard deviation over more traditional forms of instruction, which translates into about 84% of a class's students achieving a median level of performance compared to a traditional class, where only 50% of all students would achieve the same level of performance (Bloom, 1984). In Udacity MOOCs, mastery points are earned upon completion of certain questions correctly in a course, and differ among questions and among classes. Mastery levels are achievement targets for each course. Udacity courses have four different mastery levels, which are reached by accumulating mastery points. Other principles are *student engagement and long-term retention*[76].

NovoEd MOOCs go beyond the "mastery learning" model of competitors Coursera and Udacity, where the focus is on learning one set of skills in a specific subject, by adding a stronger focus on *peer learning* that brings along more versatility, broader critical thinking and problem-solving skills: "NovoEd's philosophy is to advance the online learning experience by making online courses more experiential, interactive, and collaborative. On our platform, students not only have access to lectures by thought leaders and professors from top universities, but they are also able to form teams with people around the world and work on class projects"[77]. NovoEd founders Saberi and Ronaghi find that mastery learning is more suitable for Mathematics or Computer Science courses that may work best in the lecture format, but doesn't fit so well with more open-ended courses of courses focused on teaching creative disciplines that demand more group interaction and peer-to-peer collaboration. As explained in the previous section 'Course format and principles', NovoEd MOOCs attach high importance to reputation systems, social pressure to succeed and incentives for rewarding good behaviour. NovoEd MOOCs pedagogy also focuses on improving students' soft skills and group learning skills, like virtual team management, the ability to better negotiate and understand one's role

[76] See details on https://www.coursera.org/#about.
[77] See details on http://novoed.com/.

in the team, leadership and communication. Such skills are traditionally acquired in the group-based environs of offline, in-class activities, but have largely been missing from MOOCs and this new form of online education at scale (Empson, 2013a).

Assessment

Taking into account the large number of students enrolled in the courses, all tree MOOC providers use peer assessment, i.e. students can evaluate and provide feedback on each other's work. The students are first trained using a grading rubric provided by the course teacher to grade other assessments. Peer assessment has been shown to result in accurate feedback to other students and also provide a valuable learning experience for the students doing the grading. Based on crowd-sourcing algorithms, which show how one can take many ratings (of varying degrees of reliability) and combine them to obtain a highly accurate score, multiple student grading is able to lead to grading accuracy comparable or even superior to that provided by a single teaching assistant[78].

Udacity courses have a number of problem sets, similar to the in-class quizzes which provide instant feedback and can be taken by the student any time, and final exams that can also be taken any time, with different options. All courses have final assessments that can be taken by the student on their own, while courses that need to be proctored (in order to receive credit or certification), have both a proctored exam at a Pearson VUE testing centre and an online proctored exam on the Udacity website. Udacity also provides a "testing kit" to any institution for a low fee if they are interested in providing proctored exams on Udacity courses. Among **NovoEd** courses, only one course has quizzes and the others are peer-assessed.

Accreditation

Coursera graduates to date have received a *Statement of Accomplishment* that doesn't correspond to full-fledged course credit, but may still carry some weight with graduate schools or potential employers. Academic credit for completed online work is a possibility at some stage, and the University of Washington is reported to offer credit in fall 2013 for its Coursera online courses (Anders, 2012).

Udacity graduates receive a *Certificate of Completion* indicating their level of achievement, signed by the instructors, at no cost. In addition, as of August 2012, through partnership with electronic testing company Pearson VUE, students of the introductory Computer Science course CS101 can elect to take an additional proctored 75-minute final exam for a fee of $89 in an effort to allow Udacity classes to "count towards a credential that is recognized by employers"[79]. Further plans announced for certification options would include a "secured online

[78] See details on https://www.coursera.org/#about/pedagogy.
[79] See details on http://blog.udacity.com/2012/06/udacity-in-partnership-with-pearson-vue.html.

examination" as a less expensive alternative to the in-person proctored exams. Colorado State University's Global Campus began offering transfer credit for the introductory computer science course (CS101) for Udacity students that take the final examination through a secure testing facility (Mangan, 2012).

NovoEd graduates receive a *Statement of Accomplishment*, which does not stand in the place of a course taken at Stanford or an accredited institution. The statements can be issues by NovoEd, the course provider or the course instructor.

Both Coursera and Udacity have been working with the American Council on Education's College Credit Recommendation Service (ACE CREDIT®)[80] to evaluate a selection of their courses. This is the latest component of a wide-ranging research and evaluation effort to examine the academic potential of MOOCs that ACE announced in November 2012. Through this service, students who successfully complete one of Coursera or Udacity' s pre-approved courses will be eligible to receive an ACE CREDIT recommendation, which they can present to the college or university of their choice for prerequisite or undergraduate credit consideration.

Recently, a first set of five Coursera MOOCs have been approved for "credit equivalency" by ACE, which means that any student who completes one of the five courses is now eligible to receive college transfer credit (Empson, 2013).

Four Udacity courses are still under evaluation by ACE (Developmental Math, College Algebra, Elementary Statistics and Introduction to Computer Science). Three of them (Developmental Math, College Algebra and Elementary Statistics) were created at SJSU and are pilot courses designed to boost higher education access and attainment for low-income students (see details in section 'Partners' above). SJSU will grant credit for these three pilot courses by bringing instructors and student support back in, and by providing proctored online assessments for student authentication in conjunction with the MOOC. These courses are preparatory and cover subjects that many students need to be successful in university-level courses, especially in the science, technology, engineering and mathematics (STEM) fields. ACE CREDIT will apply its evaluation process to the four courses, as well as provide ACE CREDIT transcripts for students who successfully complete evaluated courses that are recommended for college credit (ACE, 2013).

External funding

Coursera's external funding came in three rounds so far:

[80] ACE CREDIT is a recognised authority in assessing non-traditional education experiences and more than 2,000 colleges and universities consider ACE CREDIT recommendations in determining the applicability to their course and degree programmes (Source: Coursera Overview, document provided by Daphne Koller). ACE is supported by generous funding from the Bill & Melinda Gates Foundation.

a. **$16 million in Venture Round funding** from Silicon Valley venture capital firm Kleiner Perkins Caufield & Byers (KPCB) and New Enterprise Associates (NEA), (18 April 2012). Part of this investment was also the decision of veteran investor, long-time KPCB partner, and public education reform advocate John Doerr and NEA General Partner Scott Sandell to join Coursera's board of directors. The new capital aimed to expand Coursera's content and feature set and to continue developing partnerships with institutions in order to increase its global student body (Empson, 2012).

b. **$6million in additional Series A funding** from the California Institute of Technology and the University of Pennsylvania ($3.7 million) and existing venture capital investors Kleiner Perkins Caufield & Byers and New Enterprise Associates ($2.3 million to maintain their prior equity stakes in the company). The new capital announced on 17 July 2012 and was aimed at expanding college education to a mass audience (Wong, 2012).

c. **$43 million in Series B funding venture capital** from both domestic and international investors in education, like the International Finance Corporation - the investment arm of the World Bank, and Laureate Education, an international higher education company with dozens of profit-making universities around the world, as well as GSV Capital, Learn Capital and Yuri Milner, an individual entrepreneur (10 July 2013). The new round of funding reflects a move from the mainstream Silicon Valley venture capital firms to international agencies and specialised ed-tech funds, which is suggestive of Coursera's new priorities: better pedagogy and greater globalisation (Anders, 2013).

The new capital is aimed to support a significant expansion of the Coursera platform abroad in a systematic way through localisation, translation and development of strategic distribution partnerships with local institutions. Coursera is also planning to double its current staff of 50 by the end of 2013, and to bring its MOOC platform to mobile devices, searching for mobile talent and looking to build a suite of mobile apps that will enable "students to learn anywhere, on the go". Coursera has started building up a mobile devices team, so that students in emerging markets — who may not have round-the-clock access to computers with internet connectivity — can still get some of their coursework done via smartphones or tablets (Empson, 2013; Anders, 2013).

Another priority is to develop collaborative learning environments and virtual, group-based education methods that could significantly increase the value of both MOOC and online education platforms as a whole. To this end, Coursera plans to open up to applications developers to create customised apps, meant to facilitate the interaction between individual instructors or student groups (Empson, 2013; Anders, 2013). Other priorities are the advancement of techniques for flipped classroom and mastery-based learning, continued expansion of university partnerships, expanded Signature Track offerings and increased support for student technical issues.

Udacity's venture capital funding came from:

a. **$5 million in Series A funding** (January 2012) from an early-stage venture capital fund Charles River Ventures and Silicon Valley entrepreneur and UC Berkeley entrepreneurship teacher Steve Blank;

b. **$15 million in Series B funding** (October 2012) from Andreessen Horowitz. As a part of the funding, Andreessen Horowitz general partner Peter Levine is joining Udacity's board. The new funding is being used for further development of the technology platform, with mobile applications and the introduction of adaptive learning techniques which will change based on students' capabilities. Udacity courses are also planned to scale up in terms of classes offered and work more with those in related industries on graduate referrals (Perez, 2012).

NovoEd has received venture capital funding from Costanoa Ventures, Foundation Capital, Kapor Capital, Learn Capital, Maveron, Ulu Ventures and a number of angel investors. (Heussner, 2013). The amount of capital raised is not yet public, but some estimate it to be approx. $2 million (Ter Haar, 2013).

In addition to the external funding, the three MOOC providers get some additional **revenue from paid services that are offered to students in addition to the free courses,** but these revenues are proportionally much less significant. None of the three companies has a well-established business model and profit-making strategies, as they are currently experimenting with several monetisation strategies, such as:

- **Coursera** offers:
    - **The Signature Track**, which offers students the option to pay a small fee to receive verified certificates and official shareable course records. This service is purely on an opt-in basis, and access to the course remains free. Signature Track services brought in Q2 2013 more than $600,000 in revenue, up from $220,000 the previous quarter, and improved the retention rate – more than 90% of students opting for the signature track successfully complete their courses, far above the usual retention rate, as Daphne Koller noted in a recent interview (Anders, 2013).

- o **Career Services**, which offers successful students opportunities to connect with prospective employers seeking to fill positions that match their skills and interests, at the expense of the employer. In all cases, any profits generated are shared with Coursera' s university partners (6 to 15% of revenue and 20% of gross profit[81]).

- **Udacity** offers to students **optional certified exams** which have some cost to them, and also gets **referral fees** from employers who give Udacity graduates full-time positions.
- **NovoEd** explores different revenue models, including that of charging students for the statements of accomplishment, similarly to other MOOCs providers.

D2: List of contributors to the case study

Name	Organisation	Country
John Doove	Project leader, SURF	The Netherlands
Sander Latour	Project leader/student/Special Interest Group (SIG), UvA	The Netherlands
Natasa Brouwer	Coordinator, teaching staff, UvA	The Netherlands
Andy Pimentel	Chairman ICT programming council, UvA	The Netherlands
Alan Berg	Member Innovation Work Group ICT UvA, UvA	The Netherlands
Matthew D. Pistilli	Research Scientist Academic technologies, Purdue	US
Frank J. Dooley	Associate Vice Provost for Undergraduate Academic Affairs, Professor of Agricultural Economics, Purdue	US
Jean Mutton	Student Experience Project Manager, Derby	UK
Ben Bailey	Senior Assistant Registrar, Derby	UK
Suzanne Wigley	Student Experience Co-ordinator, Derby	UK
Sandra Baumgartena	Student, Derby	UK (Latvia)
Jake Hibbert	Student, Derby	UK
Myles Danson	JISC CETIS	UK
Sheila MacNeill	Assistant Director, JISC CETIS	UK

Methodological note

[81] *Coursera Overview*, document provided by Daphne Koller.

The interviews were conducted between April and July. At the University of Amsterdam and the SURF foundation the interviews were conducted face to face. Interviews with people from Purdue University, Derby University and JISC CETIS were conducted by telephone.

EU – originated MOOCs, with focus on multi- and single- institution platforms

Authors: Professor Mike Osborne and Professor Terry Mayes

Overview

a. **Drivers:** the challenge of globalisation, in particular weakening national boundaries when it comes to attracting students; and the changing supply of and demand for higher education. On the supply-side, MOOCs are used a testing ground for regular educational provisions, while on the demand side they deal students' needs and demands for flexibility of education trajectories.

b. **Strategy:** FutureLearn is developing for a set of elite UK universities (as well as an Australian and an Irish HEI) a platform to deliver MOOCs on a wide variety of devices, including smartphones and tablets. OpenHPI has delivered five MOOCs in IT that have been targeted at both specialist and general audiences in both the German and English language, and has undertaken research on learner behaviour on its platform. Leuphana has delivered one prototype course: ThinkTank – Ideal City of the 21st Century.

c. **Outcome:** three MOOC initiatives at different stages of development, one in development in the UK, FutureLearn, and two which have delivered programmes in Germany, OpenHPI and Leuphana Digital School.

d. **Key factors for success:** Each initiative has its own particular key factors of success. Most notable are the reputation of the institute/person involved (HPI/Leuphana) and the infrastructure involved (FutureLearn).

e. **Implementation challenges:** A major challenge for FutureLearn ahead of its launch was to ensure that the platform is seen as distinctive. Further, the business model is not yet clear, with several business models under consideration. OpenHPI and Leuphana do not have major implementation challenges since they are, respectively, well-funded and embedded in the developmental objectives of the university. Potential threats are seen however in expanding the use of MOOCs to more courses and to replicate the very intense support required in the model that it has used for delivery.

f. **Main changes:** A broad FutureLearn coalition has been established of more than 20 universities and other institutions (e.g. the British Museum). For HPI and Leuphana, a different entity has been established to manage the development of this new MOOC initiative.

g. **Results:**

- There are currently no outcomes at FutureLearn beyond the recruitment of 26 partners who have only in late June first seen an early version of the platform. Only in October 2013 will we be able to determine its immediate success. OpenHPI's five MOOCs have attracted up to a maximum of just over 13,000 participants per course. It has also been able to undertake some quite sophisticated research on its participants. It intends to continue developing new offers in its field. At Leuphana some 2,500 participants took the course and some 12% of the cohort graduated with four ECTS points.

- The FutureLearn model is potentially transferable, but few other countries within European have quite the combination of players of the UK. The offer of OpenHPI could be replicated by other universities if dedicated funding were made available for developing a robust platform and undertaking systematic research. Leuphana's MOOC offer is technically achievable by most universities since no special platform needs to be developed for such numbers. The quality of intensive support offered is not feasible without considerable financing.

Part A: Setting the scene: introduction, challenges and contexts

A1: Introduction / definition of the innovation initiative[82]

Overall objectives of the initiative and future plans

In this case study, we are considering three initiatives at different stages of development.

FutureLearn is a consortium-based non-US MOOC model based around prestigious UK and other Anglo universities backed by world-known UK brands (British Council, British Library and British Museum) and the UK government. It is led by a not for-profit company owned by the UK's Open University, and has been formed as a UK response to large US MOOC providers, particularly Coursera, edX and Udacity. It has high-level political support from the UK Government.

By contrast in Germany the two cases considered are niche providers with strong regional public sector and private sector support. **OpenHPI** is a development of Hasso Plattner Institute (HPI) based at the University of Potsdam in Germany. **Leuphana** is a public university in Northern Germany and it utilised the brand of the Leuphana Digital School as a platform for its online education In January 2013.

There are differences in purpose. FutureLearn is intended to attract large numbers of students globally by acting as a showcase for distinctive high-quality courses with advanced online pedagogy, and providing a test-bed for the development of learning analytics. It is primarily a

[82] Some of the issues that have emerged in these cases have been highlighted in a recent systematic review of MOOC literature (Liyanagunawardena, Adams and Williams 2013), but these researchers suggest that there is limited research in relation to MOOCs as a change agent in HE. The evidence from these cases makes a small contribution in that domain.

tool linked to the internationalisation and recruitment agenda of universities that they increasingly have to develop larger markets as public support declines in the UK. Leuphana is also aiming to attract new students, but not ones that are paying high fees since the German system does not operate according to the market system. Its objective is to provide an opportunity for overseas students to demonstrate capability prior to migration, and in that sense this is a contribution to offering lifelong learning (LLL) opportunities to such an audience. OpenHPI also in part is fulfilling a LLL role. The provision seeks to opens up higher education level provision to the German public and professionals in ways not possible in the university system, and one of its principal objectives is the broadening of access to learning within the subject domain. It therefore has the innovative intention of contributing to the challenge of providing continuing and lifelong learning opportunities in Germany, whose universities have lagged by comparison to competitor countries in this field.

The two existing initiatives in Germany in different ways contribute to research intelligence. In the case of OpenHPI, as it sits within a world-class IT research institute, this comes as no surprise. The MOOCs that it has created are living laboratories and live experiments. Amongst other things it seeks to addresses the challenge of producing new knowledge about on-line teaching, for example analysing real time behaviours in on-line environments and creating predictive models for optimal learning paths. In the case of Leuphana one of its reasons for road-testing a MOOC is to determine conditions by which credit can be offered for other programmes that might be brought to the university as part of European Credit Transfer System (ECTS). The university anticipates that larger numbers of students will carry portable credit including some gathered via MOOCs and wants to determine the conditions for quality in this mode of delivery so that it can confidently award credit.

Outcomes of the practice

Although the FutureLearn platform is not yet launched, the partnership is able to provide potentially a resource rich pedagogical environment backed by a world-leading provider of distance education, and delivered by some of the best universities in the world. HPI has offered five MOOCs concerned with IT topics. These have been targeted at specialist and general audiences in both the German and English language, with a maximum of just over 13,000 participants. Leuphana launched its first and only MOOC (albeit on a small scale with 2,500 students) with the prototype course *ThinkTank – Ideal City of the 21st Century*. In all cases designers aim for a constructivist pedagogy and learner-centred approach which in this arena has come to be known as the cMOOC.[83]

From the cases we have considered it would seem that there is strong demand for niche products, including from students outside Europe and from non-traditional students. The demand is not from simply traditional undergraduate students, but from the general public and from professionals for updating.

There is potentially a significant contribution to improving access for those who have traditionally been disadvantaged in their participation in higher education and realising the goals of the ECTS. In the early days of ICT, the use of e-learning to provide access to HE was stymied by what became known as the 'digital divide', with those from lower socio-economic groups in particular having less access to relatively expensive technologies. Furthermore the ICT infrastructure was not able to support pedagogical aspirations. Many of these historic impediments are no longer in place as the technologies have become increasingly cheap and ubiquitous. Furthermore the technology can now support the pedagogical aspirations of co-construction in real-time with a large mass of participants. It is the large mass that is needed for there to be genuine co-construction with many individuals engaged in various and complex learning interactions over a short time period to solve problems.

[83] This is based on underlying principles that relate to the developing of a connected virtual community of practice based on co-construction of knowledge. The CMOOC is distinguished from the XMOOC, which is essentially largely led by the provided material provided online, and has little by way of interaction. The idea of connectivism can be traced back to principles that emerge from situated cognition and the work of the Russian psychologist Vygotsky, and the idea of a community of practice, a term made popular by Lave and Wenger. In the field of e-learning Hung and Chen's principles of design for e-learning of commonality, situatedness, interdependency, and infrastructure are based on principles that emerge from these theoretical frameworks.

A2: Understanding of the context

The context in which the practice is developed (institutional, geopolitical, regulatory)

By late 2012, the sheer scale of the developments underway in the US implied that MOOCs could not any longer be regarded as an interesting but marginal development in borderless HE, but possibly represented a delivery method that would disrupt the model of HE in a fundamental way everywhere. The pace of commercial development also led to the view that HE institutions could not expect to experiment with MOOCs at an evolutionary rate, as they had over a number of years with virtual learning environments (VLEs). This is the point at which Martin Bean, the Vice-Chancellor of the **UK's Open University (OU)**, became personally convinced that the OU's unique position demanded that it should play a leading and proactive role in this fast-moving development. The OU is in a pioneering role over 40 years in open and distance learning. The OU has been in the forefront of this form of HE in its large-scale use of online methods and has been a leading proponent of OERs. It was the first university in Europe to reach more than a million subscriptions on its iTunes U app, with more than 85% of the learners from outside the UK. It offers a dedicated YouTube channel, a free learning resources website in OpenLearn, and a highly successful app for mobile platforms, called OUAnywhere.

Geographically, **OpenHPI** is located at the University of Potsdam, Germany within the Federal State of Brandenburg in its own building in a campus setting on land provided by the state. In terms of its geographical spread it targets an audience all around the world, but given that it has offered courses in German as well as English, it targets the German-speaking world and German diaspora. OpenHPI is a development of Hasso Plattner Institute (HPI) based at the University of Potsdam in Germany. HPI is of the university, but quite independent and effectively acts as a private institution within a public body. It is in Germany an 'aninstitut', and legally is a public-private partnership with the legal status of a GmBH, a limited-liability company in Germany. The private partner is the Hasso Plattner Foundation for Software Systems Engineering, which is the administrative body responsible for the HPI and its only corporate member.

There is a very strong technological and research context for OpenHPI since HPI has created a number of its own tools related to the delivery of e-learning. This creates an infrastructure that allows the delivery of MOOCs and analysis of impact without reliance on external input.[84]

[84] This includes the following: 1) The tele-TASK system which is described as a cost-efficient and simple way of recording and dissemination of lectures via a modern portal enhanced with a semantic search and social collaboration (http://tele-task.de/); 2) Tele-Board allows creative collaborative work in virtual, globally distributed teams (http://tele-board.com/); 3) The Tele-Lab Internet Security, which is used in teaching. Participants have the opportunity to gain access to virtual computer and network environments via the internet, as they learn about and apply security technologies (https://tele-lab.org); 4) The Semantic Media Explorer (SEMEX), which

Leuphana is a public university in Northern Germany and it has utilised the brand of the Leuphana Digital School as a platform for its online education. The institutional, geopolitical and regulatory situation of the three cases is very different, however the OU and HPI are (for different reasons) in an advantageous position to develop MOOCs. Leuphana is a small-scale initiative in a less favourable position to position itself in the MOOC-landscape.

A3: Challenges and drivers

The challenges that the initiative aims to address

The FutureLearn initiative is intended to address the challenge of attracting large numbers of students globally by acting as a showcase for distinctive high-quality courses with advanced online pedagogy, and providing a test-bed for the development of learning analytics. This goal is intended to be achieved through the innovative and learner-centred nature of the platform, the advanced pedagogy based on social constructivist principles, the reputation of the partner Universities, and the media characteristics of the courses themselves.

The provision of OpenHPI seeks to meet the challenge of opening up higher education level provision to the German public and professionals in ways not possible in the university system, and one of its principal challenges is the broadening of access to learning within the subject domain. It therefore has the innovative intention of contributing to the challenge of providing continuing and lifelong learning opportunities in Germany, whose universities have lagged by comparison to competitor countries in this field. The offer is also innovative as the activity allows experimentation based on a strong research pedigree. It addresses the challenge of producing new knowledge about online teaching.

The Leuphana digital school addresses the challenge of providing LLL opportunities to a worldwide audience, including those wishing to demonstrate capability to enter a German university from outside Europe. It also seeks to determine through its own hands-on experience the conditions by which credit can be offered for other programmes that might be brought to the university as part of ECTS.

Hence, the MOOC initiatives target two main challenges for higher education, namely, the challenge of globalisation, in particular weakening national boundaries when it comes to attracting students); and the changing supply of and demand for higher education. On the

enables semantic search in multimedia data. Data is automatically processed and semantically analysed in advance (mehr Informationen); 5) Blog Intelligence allows an efficient analysis of the exponentially growing amount of data in social networks and the blogosphere (http://blog-intelligence.com).

supply-side, MOOCs are used a testing ground for regular educational provisions, while on the demand side they deal students' needs and demands for flexibility of education trajectories.

The immediate cause for developing the initiative

The immediate cause for developing the FutureLearn MOOC was the major developments in the US that were considered to need a response. Although the OU had built a unique reputation in Online distance learning (ODL) in the UK, its attempts to develop the global market had not always met with success. There had been a particular failure to expand in the US. It had recently reduced the associate lecturers in Europe and it was, like all other UK HEIs, having to retrench financially.

The immediate purpose for developing the OpenHPI, aside from providing this LLL and public engagement role, was to fulfil HPI's own research agenda. Through OpenHPI, the Institute will not only utilise its tools and the previous insights that it has gained through research, but will seek to develop new knowledge with regard to learning processes that occur through this medium. There will thus be a flow back into its research work.

The HPI team specifically speaks about the following areas of research on OpenHPI:

- Analytics: What conclusions can be drawn from an analysis of learners' behaviour? How can these conclusions be used to improve the online learning offer?
- Semantic and Social Web: What new semantic and social web technologies can be developed to support the understanding of and navigation in online learning materials?
- Virtual Learning Labs: How can environments where learners interact with virtual IT systems be made scalable for massive participation?
- Gamification: How can the motivation of learners be increased through the functionality and design principles found in computer gaming?
- Innovative Learning Services: How can learning be promoted in the heterogeneous context of where participants live and work?

There are a number of reasons why Leuphana has gone down this route.

- One objective is to provide an opportunity for overseas students to demonstrate capability prior to migration, and in that sense this is a contribution to offering lifelong learning opportunities to such an audience.
- A second is to determine conditions by which credit can be offered for other programmes that might be brought to the university as part of ECTS. In short the university wanted to determine what the conditions for a quality course in this mode might require.

Part B: The higher education innovation system: functions, components and relationships

B1: Analysis of the functions

The function to which the innovation is related

MOOCS specifically address the education function of the higher education system. The FutureLearn partners are expected to provide a wide range of courses, targeted at different groups of learners. Effort has gone into identifying the key groups (e.g. leisure, mature, career changers, building CV, CPD etc.). At the top level the web site will offer guided support through highly user-focused searching and browsing for choosing an appropriate course, and for navigating through the alternatives. OU expertise is highly relevant here, and this is one function that is under-developed in the rival platforms. The MOOCs are positioned in a journey from informal learning, characterised by 'edutainment' through to formal learning on conventional courses. The value of designing content for its ability to engage learners from the start has been emphasised by Simon Nelson, who has criticised the way some other MOOC providers use recorded lectures. The 'pull' from edutainment was emphasised in the initial presentations about FutureLearn, but has since been argued in a more nuanced way as more data on learners' motives and expectations has become available. The analysis by the University of Edinburgh of their Coursera MOOCs has been influential in this respect. The same is true for Leuphana. The practices of OpenHPI relate to teaching, research and third mission: the MOOCs provide an opportunity to study learning behaviour in depth.

Impact of the innovation on other functions

For FutureLearn, the impact on other functions is not yet clear, however, it has established a platform on which all major players participate and cooperate. Within the OpenHPI initiative impact is on research and the third mission. The research environment of HPI has created hardware, software and a pedagogical approach that facilitates a learning environment accessible to a mass audience. Further analysis of participants is required in order to determine the role of these programmes in opening up higher education, but there is certainly an intention of doing so. In the Leuphana initiative was mentioned that for many tutors who were involved it was a better experience than the classroom with a much richer set of learning interactions. It therefore impacts not only the participants, but the facilitators.

B2: Analysis of the components

Identification and description of actors involved

FutureLearn, the company, has appointed around 15 staff on temporary contracts. The 21 UK university partners are all in the top 40 of UK universities in at least one of the league tables.

Monash University from Australia and Trinity College Dublin are also now FutureLearn partners. The consortium includes as non-HE partners the British Council, the British Library and the British Museum, who can collectively provide opportunities to market the brand internationally, offer assessment centres in many parts of the world if need be, and unparalleled resources in the form of academic materials from collections to draw upon.[85]

There is a development team for OpenHPI at HPI within its Department of "Internet Technologies and Systems". SAP AG is an actor in as much as it is the company, the world's largest maker of business management software, funds HPI. Hasso Plattner, one of its founders, owns 10% of SAP, is a professor within HPI and offered the first course in OpenHPI. There is some influence on activities from the State of Brandenburg and the University of Potsdam, as part of executive decision-making, but HPI's activities are not regulated by either the state or the university's regulatory systems. It thus is able to engage in activities which would be more challenging to do inside the state-regulated university system of Germany. However, its academic staff hold positions at the university and it contributes programmes to the university from Bachelor to doctoral level, many of which are considered to be elite and highly selective in their choice of students. The programmes that it delivers to the mainstream provide the basis for OpenHPI.

Leuphana did not develop its own infrastructure but used a customised platform that was provided by Candena. Other partners included the Fraunhofer Institute. Overall the project was part of the Leuphana Innovation Incubator Lueneburg, supported itself by the EC. Overall the investment was relatively small at €30k, but this of course does not reflect the real costs of internal and volunteer staff, key partners in the enterprise.

Implementation of the initiative

The roles of the different actors in the implementation is summarised in the table below.

Figure 13: Actors/stakeholders, level of operation, roles and responsibilities and activities

Actor/stakeholder components	Level (macro, meso, micro)	Role/responsibility	Activity
Company/team: ▪ FutureLearn	Meso	▪ Developing the MOOC	▪ Company management;

[85] The full list of University partners is: University of Bath; University of Birmingham; University of Bristol; Cardiff University; University of East Anglia (UEA); The University of Edinburgh; University of Exeter; University of Glasgow; King's College London; Lancaster University; University of Leeds; University of Leicester; Loughborough University; Monash University; The University of Nottingham; The Open University; Queen's University, Belfast; University of Reading; The University of Sheffield; University of Southampton; University of Strathclyde; Trinity College Dublin; and The University of Warwick.

Ltd ▪ Development team OpenHPI ▪ Leuphana Digital School		▪ Mobilising resources ▪ Implementing global strategy; building the platform; establishing brand; leading partnership.	▪ Platform development ▪ MOOC coordination ▪ Software development; coordinating partnership; learning analytics; rights negotiations; leading on development of business models; identification of partners.
FutureLearn: UK Open University	Macro and micro	▪ Ownership of company; distance learning expertise; academic leadership; University partner.	▪ Appointment of FutureLearn CEO; pedagogy of the platform; provision of two MOOCs.
FutureLearn: British Council	Macro and meso	▪ Promotion to international contacts.	*Possible role in proctored exams.*
FutureLearn: Proctored exam companies (e.g. Pearsons)	Macro	▪ New opportunities to exploit business model.	
FutureLearn: National regulatory bodies (e.g. QAA)	Macro	▪ Quality assurance issues for possible credit awards; quality enhancement and good practice guidelines.	*Informal discussions at this stage.*
Individual front-runners: ▪ FutureLearn: Director ▪ OpenHPI: Hasso Plattner ▪ Leuphana: Liebeskind	Micro	▪ Advocating the MOOC ▪ Convincing other partners ▪ Attracting students	▪ Organising support and awareness for the MOOcs
External stakeholders ▪ HPI: federal state of Brandenburg ▪ Leuphana: EC ▪ Leuphana:	Meso	▪ Funding arrangements (SAP) ▪ External adviser (Federal State) ▪ Offering platform for the MOOC to	▪ Developing/providing content ▪ Providing financial means ▪ Providing /adjusting the platform

Candena ▪ FutureLearn: UK Government Partner organisations: ▪ FutureLearn: 21 universities, BBC, British Museum etc. ▪ HPI: SAP		be offered ▪ Providing content ▪ Institutional backing of the initiative	
Students/academics	Micro	▪ Consumers ▪ Learning opportunities; professional development; potential impact on funding models.	▪ Engagement ▪ Feedback through questionnaires ▪ Research subjects ▪ Direct engagement with MOOCs; Development of teaching and learning activities.

B3: Analysis of the relationships

The nature of the relationship

The FutureLearn consortium does not at this stage seem legally binding, and partners can leave without penalty (as St. Andrews appears to have done). Partners are expected to commit to offer at least two MOOCs in the first instance and to run them for three years. A note in a press release makes the following important point: 'The term "partner" does not constitute a partnership in the legal sense and the Parties shall not have authority to bind each other in any way. The term is used to indicate their support and intent to work together'.

Relationships between the Open University, the FutureLearn company, and the partners are complicated by the fact that FutureLearn students will take courses on the FutureLearn platform but the MOOCs themselves will be branded by the originating university. Some of the relationships between FutureLearn and the partners will depend on whether and/or how a MOOC is monetised. FutureLearn will be expected, through the platform, to handle the issues about identifying and certifying students, and to make any arrangements for proctored exams. The Open University is closely involved with the development of the FutureLearn company, through ownership and the spinoff of its unique experience coupled with internationally recognised research. In another role, however, the OU is simply another partner in the consortium, developing its own MOOCs.

Within the consortium, there is a possibility that some partners will collaborate over particular MOOCs. New relationships between partners are actively developing. The Open University is seen as leading in learning analytics, but many partners have joined in order to experiment for themselves in online learning.

The relationships between the actors in OpenHPI cannot be fully elucidated since some aspects are clearly quite confidential. Given the funding and management structure of HPI there will be some influence from its Foundation Council and its Board of Directors. The Federal State of Brandenburg provides a plot of land near the Griebnitzsee, on which the building complexes of HPI and Potsdam University's Institute for Informatics were subsequently erected. Cooperation between HPI and the University of Potsdam is regulated by a cooperation agreement. The students at HPI are enrolled at the university, which awards Bachelor's, Master's and PhD degrees to those who have successfully completed their studies. There is no credit awarded however for the MOOCs. Most of the professors working at HPI have a joint appointment to the University of Potsdam. HPI is headed by a scientific and business director who is responsible for the day-to-day running of the institute. OpenHPI is one of a number of activities of HPI, but it does appear to be a major priority and is strongly influenced by its funder.

Changes in existing relationships

The newly joined international partners have shifted perception of FutureLearn from 'UK national' to 'non-US international', though there is a European dimension in as much as the OU has global reach and partners such as the British Council have bases in most countries of Europe. The political support from the UK government, exemplified by its promotion of FutureLearn at the G8 summit, initially seemed keen to promote this development as a UK HE promotion to international students, but the tone seems now to have shifted to one of building a multinational business in an area of disruptive technology.

There do not appear at present to be substantial changes in the nature of existing relationships between stakeholders external to HPI as a result of the OpenHPI initiative. However there appear to be changes in internal academic requirements in HPI, where there is expectancy that each of the 10 chairs will contribute to heading up a MOOC with OpenHPI. Further the development of MOOCs provides vehicles within which researchers in HPI can focus their interests and develop new lines of research. For example in interviews with researchers at HPI interesting research dimensions were discussed. There is capability for real-time analysis of behaviours in on-line environments.[86]

[86] Based on previously exhibited behaviours and linked performance, advice can be given to others of paths to take. In short predictions can be made of the optimal learning path. This is illustrated in a recent internal paper (Grunewald et al 2013b) that explores behaviour of students in one of the MOOC courses.

Impact of the relationships on the innovative practice

It is too early to identify the impact of the relationships on the innovative practice in the case of FutureLearn. In the case of OpenHPI the following can be indicated. The relation between the teaching and technical teams and students has been such that OpenHPI have been able to get good feedback (from over 40% of active participants of the course in question, numbering some 1,100 responses) Based on this experience of OpenHPI's, which was from the "Internetworking with TCP" course and its evaluative survey, their researchers have presented arguments for a future development of the xMOOC model that bridges the gap towards the cMOOC model.[87] The table below provides an overview of changed relationships in HPI.

Figure 14 Relationships between actors

Actor 1	Actor 2	Relationship	What changed?
Head of HPI	Chairs in HPI	Academic Leader for HPI as a whole, and role-model	Progressively each Chair is being encouraged to contribute to MOOC development, following the example of the Head of HPI and other key players, including Hasso Plattner
Teaching Associates and Designers	Students	Teaching Associates and Designers work in teams with a Chair, facilitate the learning process and seek evaluative feedback from student	Changes in pedagogical approach
Researchers	Students	Researchers evaluate online behaviours	Data feedback into the design of future courses

B4: Cross-elements analysis

Conclusions related to the innovation system[88]

Each case has somewhere near the top of its structure a dynamic leader and influencer: a Vice-Chancellor, formerly a Microsoft Executive and a CEO who introduced the iPlayer at the BBC in the case of FutureLearn; a founder of the world's largest maker of business

[87] They have concluded in a recent paper: 1) Learning materials could be enriched through concept maps and hypertextual links that allow diverging, learner-defined paths; 2) Hands-on exercises allow learners to feel personally involved in the problem domain through their active experimentation and to grasp the complex relations to their own concrete experience; 3) Group discussions that support awareness, and reward contributions, allow learners to feel responsible and to collaboratively strengthen the learning process and to provide richer perspectives for reflective observation. Grunewald et al (2013a: 11)

[88] As there is no single model in the three cases, no innovation map is provided.

management software who funds HPI and who fronted its first MOOCs himself; and a Leuphana course leader who is an internationally well-known architect.

In the FutureLearn model there has been strong buy-in to consortium approach by UK research-intensive universities (and beyond). To an extent these universities feel compelled to join one of the consortia, and there is something of a 'juggernaut' effect with the drivers of these heavy vehicles not sure of the destination, but sure that they have to travel. The immediate challenge facing FutureLearn is to launch in October 2013 with an advanced platform offering a number of courses from elite institutions, justifying the claim that this MOOC platform will be distinctive through the quality of the learner experience. The combination of FutureLearn staff, with successful track records in delivering high profile digital media applications, and the Open University's critical mass of researchers building on 40 years of pioneering experience in Open and Distance Learning, provides a realistic basis for meeting the significant challenges for a successful launch. In terms of what the business model might be that is as yet unsure, and FutureLearn in that sense has the characteristics of a Silicon Valley start-up company.

The German universities and institutes feel less need to outsource. Indeed HPI has developed its own platform and wonders why others have not done likewise. However the models in both OpenHPI and Leuphana are unlikely to be financially viable in most universities. OpenHPI sits in a very fortunate position. It is a well-funded public-private partnership with a remit to carry out research, and with a very stable funding stream. There are no immediate impediments to future development of its activities, and it intends to continue to develop further MOOCs in its field directed toward both professionals and the general public, and to use the environment that it has developed as a live experiment. What it is doing could be replicated by other universities if dedicated funding were made available for developing a robust platform, and to undertake systematic research. Leuphana's offer was a one-off designed for a particular purpose and although real costs were low, it was a very resource-intensive delivery system of small-group mentoring utilising many volunteer lecturers and tutors from around the world. This is not a model that could be sustained over the long term, but that was not its intention.

With regard to OpenHPI can be concluded that this is largely a top-down initiative whereby programmes are developed that are deemed to be of interest to both the general public and IT professionals, especially in the German-speaking world, and take-up indicates that this is the case. At a meso level staff members of HPI are given the opportunity to re-purpose their courses for online delivery, and from these efforts obtain considerable data for research as well as the satisfaction of making an offer to a new public. At the micro level students have the opportunity to feedback on their experience and this is integrated into new developments.

They also vicariously feed back into new development because their behaviours in the online platform are being analysed.

Part C: Outcomes, assessment and conclusions

C1: Conclusions: outcomes in terms of expected and unexpected consequences

Barriers and bottlenecks

From the perspective of the partners in FutureLearn the obstacle is to produce MOOCs of sufficiently high quality in the time available for the launch in October 2013. Partners have agreed to meet their own costs for the development of at least two MOOCs, to be offered three times. Partners have commented on the opportunity cost involved in this, which in some cases is diverting effort away from the enhancement of existing provision. It is a particular challenge to develop MOOCs before being fully aware of the functionality of the platform. An early version of the platform was only revealed to partners on 20th June. Another significant challenge is to build a platform that will be seen as distinctive at launch, while allowing individual partners to adopt their own learning designs. Also, the business model is not clear behind FutureLearn. Several business models are still under consideration.[89] OpenHPI is a well-funded public-private partnership with a remit to carry out research with strong internal technical and teaching provision, and with a very stable funding stream. There have been no obvious challenges in development. Similarly there are few internal or external challenges at Leuphana save one. The initiative is in accordance with the development objectives of the university to increase flexibility in the form in which credit can be offered. The challenge would be to replicate the very intense support required in the model that it has used for delivery.

Influence of the context on the success of the initiative

The context is a key determinant of the success of each initiative. Where the FutureLearn initiative is surrounded and supported by influential institutions, potentially creating a larger impact, the OpenHPI is situated in a favourable institutional context (Hasso Plattner, SAP). Leuphana, as a small initiative, was given the opportunity within the Innovation Incubator Lueneburg.

[89] Simon Nelson has stated: "Producing an excellent product is our primary motivation. In an evolving market, the development of sustainable business models is always a challenge but I believe that if we build something great, a whole range of business opportunities could come our way. We are looking at ways of monetising some aspects of Futurelearn including paid-for certification and proctored exams but the quality of the learning experience trumps profitability as our biggest driver every time".

Outcomes and results

In relation to FutureLearn, there are currently no outcomes beyond the recruitment of 26 partners who have only in late June first seen an early version of the platform. These include 21 UK Universities, one Australian and one Irish University, all high in international league tables. It also includes as partners the British Council, with its extensive international presence, and the British Library and British Museum with their unique digital collections. It has high-level political support from the UK Government. It launches in October 2013.

OpenHPI's five MOOCs have attracted with up to a maximum of just over 13,000 participants per course. It has also been able to undertake some quite sophisticated research on its participants, for example analysing real time behaviours in online environments and creating predictive models for optimal learning paths.[90] There are no immediate impediments to future development of its activities, and it intends to continue to develop further MOOCs in its field directed toward both professionals and the general public, and to use the environment that it has developed as a live experiment. The outcomes of OpenHPI have been a series of high quality MOOCs in the niche IT area, each with high take-up. Amongst these some for the first time have been delivered in German. They have attracted a heterogeneous clientele in terms of age and previous experience in the field of IT, being directed at both novices in the general public and professionals for updating purposes.

Some 2500 participants started and throughout the Leuphana course the same number were involved, though some left and others joined. Some 12% of the cohort graduated having completed the six assignments, which gave them five ECTS points. From 2103/14 Leuphana intends to offer a Bachelor's degree, which gives the possibility to award up to 100% credit from other programmes, and to aim this programme at the top 5% of entrants. It may be possible to integrate MOOC provision from elsewhere into this accredited Bachelor's programme. Hence Leuphana will have developed a protocol for acceptance of credit.

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[90] There has been considerable evaluation of initial courses from a student perspective. In addition to the papers of Grünewald et al (2013a and b). The first of these papers showed that respondents expressed a high degree of satisfaction with course content and structure, although the authors note the possible bias of the result, since the sample was only of active participants, and not the majority who did not continue the course. Respondents were also able to give open response feedback and recommendations for improvement to the platform and content – these recommendations are being addressed in future courses. It also produces guidelines for MOOCs for supporting experiential learning based on Kolb's (1984) model. In the second paper, Grünewald et al (2013b) assesses the behaviours of the students in the online environment, and offers a typology of five types of participant correlated to levels of participation using Fishcher's (2011) model as developed by Dick and Zietz (2011). In a further paper (Willems, Jasper, and Meinel 2013), OpenHPI report on an experiment with three practical tasks that were implemented as assessed bonus exercises. This study showed that graded hands-on assignments for their MOOCs can be provided without the need for major adaptions to the learning platform and without the provision of a resource intensive centralised training environment infrastructure. These are concrete research results related to pedagogical and design issues related to MOOCs that may have general application for other providers.

Transferability

FutureLearn is positioned as a major player in the emerging MOOC ecosystem, following an 'agile' development path. This development philosophy extends to the question of a business model, where a number of possible monetising approaches will remain under consideration even after the launch. This approach raises the risk level for the success of the company but allows a learning process to underpin the overall venture. The model is potentially transferable, but few other countries within European have quite the same combination of players as the UK.

The model that HPI has developed is transferable to other universities if there is a willingness to invest. Although OpenHPI enjoys the advantage of private sector funding and autonomy, what they offer is within the grasp of other universities in technical and pedagogical terms. Many universities would have the capability of developing their own platform and expertise in designing and delivering on-line courses. The mode that is being offered by OpenHPI is very robust and supported by a strong technical and academic infrastructure. However, the pedagogical framework is not particularly radical. OpenHPI is not however seeking to generate a surplus or attract high-fee paying international students. Its role is opening up the discipline to a wider audience in the spirit of LLL and in return accessing a massive sample of research data. There may then be spill-over effects for the University of Potsdam since it will be identified with a popular and high quality niche offer. If other universities want to replicate this model, then as its Director has said, this is not difficult to do.[91]

The Leuphana type of MOOC offer is technically achievable by most universities since no special platform needs to be developed for such numbers. The quality of intensive support offered is not feasible without considerable financing.

To conclude, from the cases we have considered it would seem that there is strong demand for niche products, including from students outside Europe and from non-traditional students. The demand is not from simply traditional undergraduate students, but from the general public and from professionals for updating their knowledge. Furthermore, there is potentially a significant contribution to improving access for those who have traditionally been disadvantage in their participation in higher education and realising the goals of the ECTS. In the early days of ICT, the use of e-learning to provide access to HE was stymied by what became known as the 'digital divide' with those from lower socio-economic groups in particular having less access to relatively expensive technologies. Moreover, the ICT infrastructure was not able to support

[91] In interview, Prof. Dr. Meinel MOOCs suggests that MOOC models such as Coursera are good for professors to market themselves, but not for universities since it does not highlight their distinctiveness. The development of platforms is not technically difficult, but it does require development time, and this might be a price worth paying to highlight the work of a particular university as against a consortium.

pedagogical aspirations. Many of these historic impediments are no longer in place as the technologies have become increasingly ubiquitous and cheap. Additionally, the technology can now support the pedagogical aspirations of co-construction in real-time with a large mass of participants. It is the large mass that is needed for there to be genuine co-construction, with many individuals engaged in various and complex learning interactions over a short time period to solve problems.

Annexes

D1: List of literature used

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D2: List of contributors to the case study

Name	Organisation	Country
Prof Hugh Davis	Head of CITE University of Southampton	UK
Prof Frank Coton	Deputy Principal University of Glasgow	UK
Simon Nelson	Launch CEO FutureLearn	UK
Simon Pearson	Senior Project Manager FutureLearn	UK
Matthew Karas	Chief Technical Officer FutureLearn	UK
Prof Jeff Haywood	CIO and VP University of Edinburgh	UK
Matthew Shorter	Head of Content FutureLearn	UK
Prof Mike Sharples	Head of IET and Academic Lead for FutureLearn Open University	UK
Christian Willems	Head of the Technology Team and Project Co-ordinator, OpenHPI	Germany
Prof. Dr. Christoph Meinel	Director, OpenHPI	Germany
Matteus Bauer	Research Associate, OpenHPI	Germany
Dr Sebastian Leder	Personal Assistant to Prof. Dr. Christoph Meinel , OpenHPI	Germany
Holm Keller	Executive Vice President for Strategic Development and Administration, Leuphana University Lüneburg	Germany

Annex D3

Case 1: FUTURELEARN: A partnership for MOOCs

Part A: Setting the scene: introduction, challenges and contexts

A1: Introduction

FutureLearn Limited (http://futurelearn.com) was formed in December 2012 to create the first UK-led, multi-institutional platform for free, open, online courses. It was registered as a private limited company in December 2012, incorporated in England under registration number 8324083. The Directors are all OU senior managers, including Martin Bean, the Vice-Chancellor. The OU is probably the UK's most prestigious research centre, and one that is world leading, for the development of technology-enhanced distance learning. Between its Institute for Educational Technology (IET) and Knowledge Media Lab (KMI) it hosts a critical mass of researchers. It also is the leading UK institution for the promotion of open educational resources (OERs).

The stated intention is to create a high quality single website giving open access to a range of courses provided by elite universities, running on a common platform.

The fundamental aim of FutureLearn is to offer a viable commercial alternative to the rapid growth of US-based MOOCs (Massive Online Open Courses). It aims to base its appeal on quality: the quality of the learning materials, the quality of the learning experience, the quality of the platform, and the quality of the partners. FutureLearn is a for-profit private company majority owned by the UK's Open University (OU). It is also a partnership (in a non-legal sense) and the company was formed with 11 University partners already in place. Since then the consortium has grown rapidly. It currently has 26 partners and is expected to launch its first MOOCs in October 2013.

It is assumed that FutureLearn will build on the OU's 40 years of experience in delivering distance learning and in pioneering open education. There are still at present several business models on the table.

A2: Understanding of the context

By late 2012, the sheer scale of the developments underway in the US implied that MOOCs could not any longer be regarded as an interesting but marginal development in borderless HE, but possibly represented a delivery method that would disrupt the model of HE in a fundamental way everywhere. The pace of commercial development also led to the view that HE institutions could not expect to experiment with MOOCs at an evolutionary rate, as they had over a number of years with VLEs. This is the point at which Martin Bean, the Vice-Chancellor of the UK's Open University, became personally convinced that the OU's unique position demanded that it should play a leading and proactive role in this fast-moving development.

There are two reasons for regarding the OU as the right institution to lead a national response in this area. The first is the rather unusual personal experience that Martin Bean had brought to his role as Vice-Chancellor. Before joining the OU in October 2009 he had no direct experience of HE. He had extensive experience, however, of developing technology approaches to the global training and education marketplace. He had been responsible for product management, marketing and business development for the Education Products Group at Microsoft. He had previously worked at Novell, Sylvan Learning, and Thomson Learning. In particular Martin had an extensive network of contacts in the world of digital publishing and educational media.

The second reason is the pioneering role over 40 years played by the OU itself in open and distance learning. The OU has been in the forefront of this form of HE in its large-scale use of online methods and has been a leading proponent of OERs. It was the first University in Europe to reach more than a million subscriptions on its iTunes U app, with more than 85% of the learners from outside the UK. It offers a dedicated YouTube channel, a free learning resources website in OpenLearn, and a highly successful app for mobile platforms, called OUAnywhere. Particularly relevant are its research centres in this area, namely the IET and the KMI. IET has an international reputation for its expertise in online pedagogy, particularly in the use of OERs, and in mobile learning. The KMI was set up in a convergence of areas that impacted on the OU's distinctive mission: Cognitive and Learning Sciences, Artificial Intelligence and Semantic Technologies, and Multimedia. The KMI's research focuses on the areas of future internet, knowledge management, multimedia and information systems, narrative hypermedia, new media systems, semantic web, knowledge services and social software. Together, the IET and KMI are leading UK research in the emerging area of learning analytics, which may underpin FutureLearn's development. Researchers from these units have been highly active in many EU R&D programmes, including the coordination of STELLAR, the EU's 7th Framework Network of Excellence in technology enhanced learning. As we will describe below they have had, and are having, a key role in the development of the FutureLearn platform.

A3: Challenges and drivers

Having decided that a major development in MOOCs was the needed response to the US drive in this area, Martin Bean was faced with the decision first of whether the OU itself was in a position to succeed under its own brand. Although it had built a unique reputation in ODL in the UK, its attempts to develop the global market had not always met with success. There had been a particular failure to expand in the US. It had recently reduced the associate lecturers in Europe and it was, like other UK HEIs, having to retrench financially.

Initially, Martin sought advice from amongst the OU's own staff and appointed an advisory group, which included Mike Sharples, the Head of IET and Mark Lester, the OU's Head of Strategy Development. Their advice led to a decision that a new platform would need to be developed that would be designed from scratch to scale for MOOCs, and would be aimed particularly at mobile devices, such as smartphones and tablets. The main online platform for its own distance learners, Moodle, would not scale to the numbers of learners anticipated for MOOCs, nor was it suitably designed for multiple devices. At the same time it seems that Martin Bean sought political support from the UK government for a UK-wide initiative in this area, and this support was quickly forthcoming. He then set about recruiting support from among the community of Vice-Chancellors. In November 2012 a high-profile contact was recruited from the world of digital media, Simon Nelson, to lead the effort to develop the platform. The company was formed in December, already with 11 universities as the initial partners in the FutureLearn consortium.

The next major challenge was to equip the initiative for a rapid development process. By late 2012 the US MOOC platforms were expanding at a significant speed, not typically associated with the pace of change in HE. Partnerships were adding institutions almost daily and the number of courses on offer seemed to be growing exponentially. It seemed necessary to adopt practices from dotcom startups and consumer technologies, from the world of agile software development, if a new platform was to be ready to support learners on courses from the partners in an acceptable timescale.

From its formation, FutureLearn has had a dual identity. It is, on the one hand, a comparatively small platform-development company, and on the other, a partnership of elite universities with their own established and prestigious HE brands. The need for rapid development of the platform was seen as necessitating a specially recruited development team. Simon Nelson has recruited on freelance contracts around 15 staff, most of whom have, like him, a background in the development of platforms and applications for digital media, and a track record of successful delivery.

FutureLearn staff has adopted the approach known as *agile development*. Indeed, familiarity with this approach may have been an essential competence for recruitment. The essence of this methodology involves rapid, continuous delivery of useful software. There is an emphasis on frequent interactions between developers, testers and potential users as the development proceeds, rather than on fixed procedures, processes or tools. In the case of FutureLearn, prototype software is delivered and progress reviewed every two weeks. There is daily interaction, in the form of a 'scrum' or informal meeting managed by a 'scrum master', between business people and developers to ensure regular adaptation to changing circumstances. Changes in requirements are expected and welcomed, however late.

FutureLearn needs both a high quality platform and high quality courses to run on them. For course development the strategy is to associate with the brands of universities that have much to lose in reputational terms if course quality is lacking. According to Simon Nelson's own account, the consortium was initially "inundated with requests to join" from UK universities. A quality criterion was quickly adopted for allowing membership of the consortium: this was based on University league tables. A FutureLearn member institution needed to be ranked in the top 40 of UK institutions, and in the top 30 in at least one of the league tables. This decision has created some negative comment that FutureLearn has chosen to create a consortium based on elite values, largely dependent on reputation for research, that do not align with the kind of entrepreneurial approach for teaching that MOOCs seem to demand. This criticism, of course, does not apply to the OU but the policy may well exclude those UK HEI's that have the strongest links with schools, FE Colleges, CPD and lifelong learning in general. Currently there are 23 University partners: 21 of these are UK universities that meet the criteria. The other two University partners, in a recent move that seems significantly to change the general perception of what the partnership represents are Monash University, Australia's largest university, and Trinity College Dublin. In short the initiative is not simply from the UK, but one that is developing from the wider non-Anglo English-speaking world. However, it is interesting that at this point what are probably the five most prestigious UK universities (Oxford, Cambridge, UCL, LSE, Imperial) have not so far joined. The University of St Andrews was an original member of the partnership but has since withdrawn.

The partner institutions also include the non-HE British Library and British Museum, with their already extensive online collections. Finally, the British Council is a FutureLearn partner, offering an extensive international network and a presence in many countries with large numbers of potential students. The political importance of FutureLearn was underlined by its inclusion in the Prime Ministerial visit to India in February 2013. Martin Bean was joined on the visit by VCs from the universities of Cardiff, Exeter, Southampton and Warwick and the CEO of the British Library. This positioning of FutureLearn as a key UK business development was strengthened by showing a video about FutureLearn at the G8 Summit in June 2013.

From the perspective of the partners the main challenge is probably to produce MOOCs of sufficiently high quality in the time available for the launch in October 2013. Partners have agreed to meet their own costs for the development of at least two MOOCs, to be offered three times. Partners have commented on the opportunity cost involved in this, which in some cases is diverting effort away from the enhancement of existing provision. It is a particular challenge to develop MOOCs before being fully aware of the functionality of the platform. An early version of the platform was only revealed to partners on 20th June.

A significant challenge is to build a platform that will be seen as distinctive at launch, while allowing individual partners to adopt their own learning designs. Partners will need to convince sceptics, particularly those from within an institution, that joining the FutureLearn consortium is consistent with a clear strategy for the future development of that institution's educational offering, and for reaching out to new potential students.

Several business models are still under consideration. Simon Nelson has stated: "Producing an excellent product is our primary motivation. In an evolving market, the development of sustainable business models is always a challenge but I believe that if we build something great, a whole range of business opportunities could come our way. We are looking at ways of monetising some aspects of FutureLearn including paid-for certification and proctored exams but the quality of the learning experience trumps profitability as our biggest driver every time".

The three partners interviewed were explicit about not initially expecting a commercial return through monetisation of MOOCs. The expected long-term benefits were developmental in their core businesses. They referred to the opportunity for raising capacity in the technology of online education provided by this initiative. The University of Edinburgh regards its participation as part of a wider institutional research and development programme, aimed at maintaining its position as an innovator in online methods. The Universities of Glasgow and Southampton also see their participation as contributing to the strategic goal of delivering mainstream courses in a blended way for both campus-based and distance students. Both of these institutions regard themselves as currently 'behind the curve' in online distance education and justify their participation in FutureLearn as a learning opportunity for the institutions and their staff. Each of these example institutions therefore sees this MOOC initiative in long-term developmental terms and is agnostic on the shorter-term benefits.

Part B: The higher education innovation system: functions, components and relationships

B1: Analysis of the functions

FutureLearn is being designed to offer the following distinctive functions.

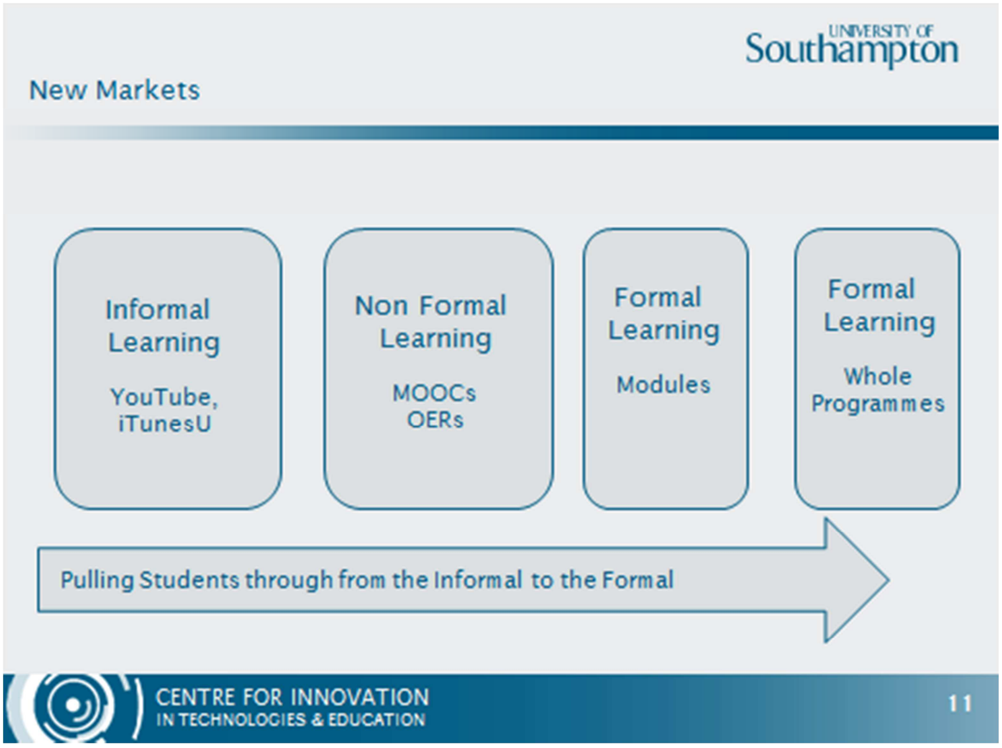
Courses matched to users

The FutureLearn partners are expected to provide a wide range of courses, targeted at different groups of learners. Effort has gone into identifying the key groups (e.g. leisure, mature, career changers, building CV, CPD etc). At the top level the website will offer guided support through highly user-focused searching and browsing for choosing an appropriate course, and for navigating through the alternatives. OU expertise is highly relevant here, and this is one function that is under-developed in the rival platforms.

Pathways to formal learning

Figure 1 illustrates the positioning of FutureLearn MOOCs in a journey from informal learning, characterised by 'edutainment' through to formal learning on conventional courses. The value of designing content for its ability to engage learners from the start has been emphasised by Simon Nelson, who has criticised the way some other MOOC providers use recorded lectures. The 'pull' from edutainment was emphasised in the initial presentations about FutureLearn, but has since been argued in a more nuanced way as more data on learners' motives and expectations has become available. The analysis by the University of Edinburgh of their Coursera MOOCs has been influential in this respect.

Figure 15: An initial presentation of the 'pathway to formal learning' argument



FutureLearn pedagogy is to be based on social constructivist learning principles

A distinctive feature of FutureLearn is its foundation on sound pedagogic principles, those associated with a social constructivist theory of learning. The design of the platform has been influenced from the start by the need to support those principles, interpreted by the team led by Mike Sharples, the 'academic lead'. Two basic ideas have been used to guide the designers:

- The Laurillard/Pask model of conversational learning;
- The Vygoskian concept of the 'Zone of Proximal Development'.

These ideas have been unpacked in a way that clarifies the role of social media. Learning proceeds through dialogue, often between peer learners, and the relationship of one learner to another becomes key in determining the learning that occurs. The Vygotskian notion of scaffolding can be related to 'following' in Twitter or Facebook. However, as Sharples has put it, "the ZPD isn't just Twitter and conversational learning isn't just connecting learners". Sharples has described in interview the intense dialogue between the pedagogy experts and the platform developers that has demonstrated the value of agile development. "So we've arrived now at what we call Conversational Learning 2.0 within a social learning platform."

A key aspect of this approach will be to use algorithms to match peer learners to others with similar interest and recommendations. Contributions from all peers will appear in an activity feed, but ordered in a priority determined by the algorithms. The priorities may be determined partly by the individual learner's own choices, recommendations and responses, but also by variables set by the system, or by tutors (who may be in a teaching role from the start, or may be peers who are promoted into the role and badged). A second important principle is that all activity will be linked back to content, thus contextualising it.

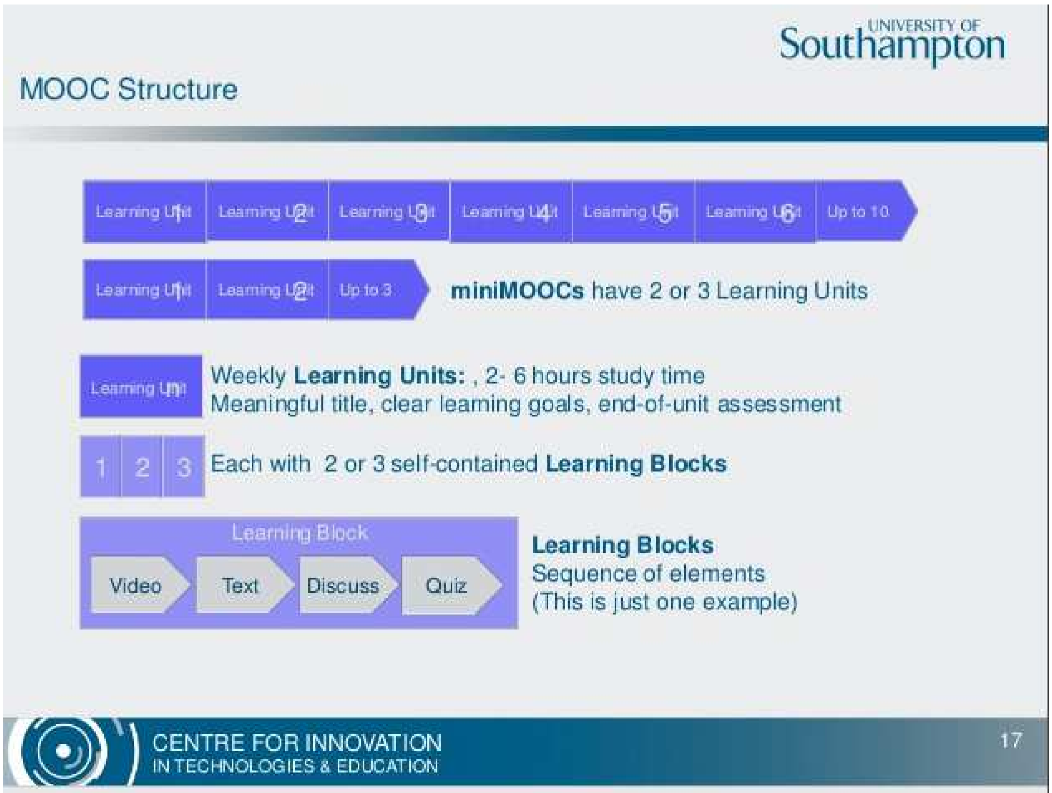
The role of assessment in FutureLearn will also be consistent with social constructivism

As with all MOOCs, it is obvious that assessment will play a key role in the FutureLearn platform, particularly in a formative sense, but the extent to which assessment principles will be built into the platform itself are still being debated by the development team. It is likely that the first courses to be offered will not display advanced functions for automated assessment and feedback, although the role of peers in formative assessment may be managed through the activity feed. The range of possibilities for development after the launch includes high-stakes assessment and proctored exams, possibly approaches similar to Coursera's signature track, and MCQs with feedback and links back to content. For proctored exams, discussions are underway with the British Council, which is of course well placed to lead on the setting up of these internationally. Other approaches are still under active consideration and this is an aspect of FutureLearn that seems less advanced than most other dimensions of the developing platform.

The structural features of a FutureLearn MOOC

Partners will be given flexibility over the structure of a course on FutureLearn but some constraints will be set by the high-level structure assumed by the platform. Some details of these assumptions can be seen in Figure 2. FutureLearn is currently running workshops for partners, offering training for course development within the broad FutureLearn guidelines.

Figure 16: The early FutureLearn MOOC structure



FutureLearn will allow both xMOOC and cMOOC approaches, although currently the developing platform seems more likely to be characterised as supporting xMOOCs. Nevertheless, the emphasis on learning through social media and learner-created material linked to the original content will give partners the opportunity to create MOOCs with a highly connectivist flavour (as one of the Edinburgh MOOCs was able to demonstrate even on the Coursera platform).

FutureLearn is being designed for mobile devices

The FutureLearn platform development team have brought a culture of integrating digital media and communications into a users' everyday pattern of activities. Thus, learning through MOOCs was seen from the start as something a learner would do opportunistically. It followed that the platform has been designed for mobile devices, particularly smartphones and tablets. This means that there are constraints on what applications are possible e.g. Flash. The academic group from the OU have modified this approach somewhat by insisting that delivery on desktops must remain viable. Nevertheless, one can see here an indication of how MOOC development is likely to impact on the partners' mainstream blended delivery. In interview partners have expressed the hope that the lessons learned in developing courses for FutureLearn will lead to a deeper understanding of how to respond to the changing undergraduate culture.

FutureLearn intends to make full use of learning analytics

The FutureLearn platform will be designed to capture 'big data' on student patterns of use. This offers, as do the other MOOC platforms, an unprecedented opportunity for experimentation. Perhaps for the first time we can see the prospect of a science of pedagogy based on quantitative data. The platform will be capable from the start of capturing and mining data on many variables, from individual learner patterns to statistics across courses. The partners interviewed have all emphasised this as a key reason for joining FutureLearn. FutureLearn as a platform is viewed by its developers as a continuously changing design, its capabilities and affordances responding to its own data. This is, of course, consistent with the philosophy of agile development. As Simon Nelson has put it: "Once we get started later this year, we'll be collecting information as we go to iterate on the process, developing our understanding of how FutureLearn students are learning and responding to the courses. The more of this we gather and analyse, the more we'll be able to refine and improve the experience".

B2: Analysis of the components

Identification and description of actors involved in implementation of the initiative)

FutureLearn, the company, has appointed around 15 staff on temporary contracts. Table 1 provides information on current senior FutureLearn staff.

Table 18: Key FutureLearn staff

Name	Position in FutureLearn	Background
Simon Nelson	Launch CEO	Head of Strategy: BBC Radio Head BBC digital: Launched BBC podcasting and i-Player
Matthew Walton	Product Lead	BBC Worldwide: Head Online Development
Matthew Karas	Launch CTO	Freelance Developer. Director VideoJug, enthuse.me
Mark Lester	Head UK Education & HE Partnerships	Head Strategy Development, Open University
Simon Pearson	Senior Project Manager and 'scrum master'	Senior Production manager, Channel 5; Technical Project Manager BBC Worldwide
Matthew Shorter	Head of Content	Director, Unthinkable Consulting; Programme Manager ITV web relaunch
Claire Davenport	Commercial and Operations Director for launch	Chief Commercial Officer Bigpoint. Head of Staff Skype. Deputy Head Strategy Ofcom

The Directors of FutureLearn are senior OU managers, including Martin Bean. Advertisements are starting to appear for learning technology posts in individual partner institutions to work on FutureLearn course development. It is believed that (at least part of) the platform development is currently being outsourced to the software company Go Free Range.

At the OU some of the senior staff of the IET and the KMI, highly regarded internationally for the areas of e-pedagogy, learning analytics and OERs, are directly involved in the agile development process. The 'Academic Lead' of FutureLearn is Mike Sharples, the Head of IET.

The FutureLearn Consortium

The 21 UK university partners are all in the top 40 of UK universities in at least one of the league tables. The only one of these already to have offered MOOCs is the University of Edinburgh, the first (and so far only) UK University to offer MOOCs on Coursera. Monash University from Australia and Trinity College Dublin are also now FutureLearn partners. The consortium includes as non-HE partners the British Council, the British Library and the British Museum, who can provide collectively opportunities to market the brand internationally, offer assessment centres in many parts of world if need be, and unparalleled resources in the form of academic materials from collections to draw upon.

The full list of university partners is: University of Bath; University of Birmingham; University of Bristol; Cardiff University; University of East Anglia (UEA); The University of Edinburgh; University of Exeter; University of Glasgow; King's College London; Lancaster University; University of Leeds; University of Leicester; Loughborough University; Monash University; The University of Nottingham; The Open University; Queen's University, Belfast; University of Reading; The University of Sheffield; University of Southampton; University of Strathclyde; Trinity College Dublin; and The University of Warwick. Interviews have been conducted with three of the partner institutions.

University of Southampton

Southampton has recently launched a strategic drive to develop online learning in all areas of teaching. The institution has funded a new centre, the Centre for Innovation in Technologies and Education (CITE) with the aim of directly supporting online development in the faculties and raising awareness and understanding of e-pedagogy and online methods across the institution. CITE's Head, Hugh Davis, has been given the responsibility for the production of the first two MOOCs: Web Science and Oceanography. These are two of the areas of research strength of the University, which sees FutureLearn membership as an opportunity to enhance reputation in areas of potential student growth. CITE feels it will grow capacity in online development through its association with FutureLearn and with the OU. This enhanced capability will be reflected in its support for mainstream undergraduate and taught Masters courses in the Faculties. In the short term there is some risk that MOOC development will divert resources away from CITE's primary role, but early indications are that the interest generated by the FutureLearn partnership will more than compensate.

University of Glasgow

Glasgow's motives for joining FutureLearn are aligned with their strategic need to develop distance learning across all subject areas. The University is positioned at the bottom of the Russell Group in this respect. It is interested in the possibilities for hybrid approaches – where MOOCs are taken by fee-paying students as part of a credit bearing course. There is a need to introduce blended approaches at undergraduate level and MOOC development is seen as acting as a catalyst for this. Joining FutureLearn is a signal to all staff that the University is serious about moving in that direction. At the time of the interview the University was waiting to discover what response had been made to its open call for MOOC proposals. It has offered funding of £30K per MOOC for development, though subject areas would be expected to cover any costs involved in running and maintaining these courses.

University of Edinburgh

Edinburgh is the first UK University to offer MOOCs, which it has done in 2012/13 through its partnership with Coursera. It has made public a detailed research report into the experience, including data on each of the six MOOCs that have run. Becoming a FutureLearn partner has therefore been undertaken from a position of better understanding what is involved than most other partners. A motivation for joining is partly to maintain its reputation for leading in this area, and partly to be able to experiment further. It intends to base an expansion of blended approaches in undergraduate provision to a large extent on the evidence that will be gained through FutureLearn. It acknowledges that there is an opportunity cost involved here but does not expect MOOC development to detract from effort expended on its main strategic drive in online distance learning aimed at taught Masters. It is explicit about not expecting to develop income through MOOCs in any direct way.

B3: Analysis of the relationships

Table 19: FutureLearn stakeholders and their roles: actual and potential.

Actor/stakeholder components	Level (macro, meso, micro)	Role/responsibility	Activity
UK Open University	Macro and micro	Ownership of company; distance learning expertise; academic leadership; University partner.	Appointment of FutureLearn CEO; pedagogy of the platform; provision of 2 MOOCs.
FutureLearn Ltd.- a for-profit company.	Micro and meso	Implementing global strategy; building the platform; establishing brand; leading partnership.	Software development ; coordinating partnership; learning analytics; rights negotiations; leading on development of business models; identification of partners.
UK University partners	Macro and micro	Institutional reputation, experimentation in online distance learning, possible revenue streams through international student uptake.	Development of MOOC courses; learning analytics; possible monetisation through completion certificates/credits.
International	Macro and	As for UK plus	As for UK

University partners	micro	international reach; impact on FutureLearn policies in different practices and cultures for learning.	
British Council	Macro and meso	Promotion to international contacts.	Possible role in proctored exams.
British Museum, British Library	Macro and meso	Extending role into global HE.	Use of digital collections in MOOC development.
Proctored exam companies (eg Pearsons)	Macro	New opportunities to exploit business model.	
UK Government	Macro	Global position of UK HE; promotion of digital media as UK growth sector	Political support; possible funding guarantees for OU risk.
National regulatory bodies (e.g. QAA)	Macro	Quality assurance issues for possible credit awards; quality enhancement and good practice guidelines.	Informal discussions at this stage.
Students Academics	Micro	Learning opportunities; professional development; potential impact on funding models.	Direct engagement with MOOCs; development of teaching and learning activities.
Employers	Micro	Potential closer involvement with HE provision.	Tailoring of MOOCs for employment; recognition of completion certificates.

B4: Cross-elements analysis

The consortium does not at this stage seem legally binding, and partners can leave without penalty (as St. Andrews appears to have done). Partners are expected to commit to offer at least two MOOCs in the first instance and to run them for three years. A note in a press release makes the following important point: 'The term "partner" does not constitute a partnership in the legal sense and the Parties shall not have authority to bind each other in any way. The term is used to indicate their support and intent to work together'.

Relationships between the OU, the FutureLearn company, and the partners are complicated by the fact that FutureLearn students will take courses on the FutureLearn platform but the MOOCs themselves will be branded by the originating university. Some of the relationships between FutureLearn and the partners will depend on whether and/or how a MOOC is monetised. FutureLearn will be expected, through the platform, to handle the issues about identifying and certifying students, and to make any arrangements for proctored exams. The OU is closely involved with the development of the FutureLearn company, through ownership and the spinoff of its unique experience coupled with internationally recognised research. In another role, however, the OU is simply another partner in the consortium, developing its own MOOCs.

Within the consortium, there is a possibility that some partners will collaborate over particular MOOCs. New relationships between partners are actively developing. The Open University is seen as leading in learning analytics, but many partners have joined in order to experiment for themselves in online learning.

The newly joined international partners have shifted perception of FutureLearn from 'UK national' to 'non-US international', though there is a European dimension in as much as the OU has global reach and partners such as the British Council have bases in most countries of Europe. The politically supportive UK government, exemplified by its promotion of FutureLearn at the G8 summit, initially seemed keen to promote this development as a UK HE promotion to international students, but the tone seems now to have shifted to one of building a multinational business in an area of disruptive technology.

Part C: Outcomes, assessment and conclusions

C1: Conclusions: outcomes in terms of expected and unexpected consequences

All parties acknowledge that the FutureLearn venture is a step into the unknown. It is not a development that has emerged through the normal innovation process of quality enhancement. It is primarily a response to the developments of US MOOCs, with their potentially disruptive combination of elite US universities on the one hand, and fast-moving venture capitalists and entrepreneurial faculty on the other. Some would argue that MOOCs are not like any previous innovation in HE at all. They are not offering an enhancement in an area of HE that needs some improvement, they seem closer to a reconceptualisation of the basic model of HE. So in that case it seems a high risk strategy to offer free high quality HE courses to a global market without a clear understanding of the likely impact on student recruitment for conventional HE. Indeed, it seems particularly risky for the OU, the originator of FutureLearn, yet also the UK institution that would seem to have most to lose from establishing a partnership that will offer a new global brand for open HE, without cost to the end user. Against this, however, it is argued that it is quite wrong to view MOOCs as a free version of HE, on the contrary they are a level of edutainment that encourages learners to see that learning can be fun and social, and they give a sense to a new learner of how mainstream HE (even online) can offer great personal benefits. In this view, MOOCs are an exciting way of promoting HE and their impact will be to greatly raise the profile of MOOC providers in the 'HE ecosystem'.

In the interviews for this case study it has been striking to discover that those involved are quite relaxed about the lack of a clear business model. Indeed, for the FutureLearn staff it seems a positive by-product of the agile development approach that a number of monetisation possibilities should remain on the table. FutureLearn is committed to what the staff regard as the Silicon Valley approach – 'build a great application and offer it to the world and business models will follow'. The university partners who were sampled held a similar view, regarding FutureLearn as an opportunity to experiment with new learning and teaching methods without the constraints imposed by a credit-bearing curriculum. There are many potential pitfalls ahead for this initiative. Key challenges are as follows:

Quality

FutureLearn is attempting to distinguish itself from the US MOOC providers through the quality of its platform, its learner experience, its institutions and its courses. It has put in place a limited amount of user testing of the platform, and the partnership has agreed on a quality assurance procedure for courses based on the principle of peer review. Nevertheless, it faces a difficult balance at launch, with the need to demonstrate that high quality has already been achieved while at the same time making it clear that the offering will be subject to a process of continuous improvement as data cumulates on the patterns of learner behaviour. The partners also face challenges in MOOC production. It will not be easy to divert resources to a form of course development that has no immediate prospect of meeting costs from income. Finally, its brand will suffer from the continued absence of the five or six highest rated UK universities.

Funding

It is not clear how far FutureLearn can proceed as a company without an early income stream. Details of any government guarantees on funding are not available. There will obviously be limits on the extent of continued OU support without such backing.

Pace of development

There is a clear danger that this initiative will be overtaken by events, and by the intense competition that is emerging in this area. The number of specialist MOOC platforms is already extensive and is growing rapidly. Blackboard, for example, has just announced a MOOC version of its platform that will be offered to all its current VLE licensees. The competition from within HE is also likely to intensify. Those HE institutions excluded from the FutureLearn partnership are likely to make their own arrangements to enter the MOOC space. There are also emerging partnerships around the US platforms, with employers, proctored exam agents, and publishers offering an enhanced MOOC product. It is also unclear whether, in a context of rapidly increasing choice for learners, the 'M' part of the acronym will continue to refer to very large numbers of students. On the other hand, some comfort can be drawn from the fact that the Edinburgh MOOC on equine nutrition attracted 19,000 *active* participants, suggesting that MOOC providers may have a long way to go yet to fully meet the global demand in niche areas.

We should note that there is relevant context in a previous large-scale UK-based attempt to create a sector-wide body to exploit the growth in global online HE. This was the UK e-University (UKeU) which launched its first courses online in March 2003 and ended in failure, with significant loss of public money, in July 2004. Some of the lessons of that failure seem relevant to FutureLearn. In particular, the final official judgement on the failure attributed it to its supply-driven rather than demand-led approach in an emerging market, and to its lack of market research into the level or nature of consumer demand. This makes rather uncomfortable reading for FutureLearn. So does the conclusion that 'realism about differentiators is necessary: quality is not a differentiator; price is; platform functionality is not'. On the other hand, EU-funded work on critical success factors for virtual universities emphasises some of the features that FutureLearn displays: high binding energy through managed diversity, and stratified consortia (i.e. universities at a similar level in the rank order).

A more recent context in UK HE is one of turbulence around funding. This would seem to make the lack of a clear business model even more surprising. A counter argument, however, is that a new business realism in HE, particularly around the internationalisation of HE, is encouraging entrepreneurial activity of the kind FutureLearn clearly represents. A more traditional evolutionary process through step-by-step quality enhancement may no longer be an option.

There are currently no 'outcomes and results' in the conventional sense from this case study. At the time of writing the FutureLearn staff are under great pressure to meet the deadline for the launch with a platform that will fulfil expectations. The partner institutions will also be challenged to produce MOOCs to the quality standard expected in the time available. Meanwhile, news about MOOC developments elsewhere emerges daily. Some pointers to FutureLearn's success will be available at launch but a clear picture will not emerge until the first tranche of MOOCs have run and the data has been analysed. We can expect the partnership to continue to grow internationally, and for some existing partners to drop out as their commitments prove too onerous. This case study can only be read as a snapshot at a particular moment in time, in a rapidly and unpredictably evolving global context.

Annex D4

Case 2: OpenHPI: A German niche market operator

Part A: Setting the scene: introduction, challenges and contexts

A1: Introduction / definition of the innovation initiative

Overall objectives of the initiative and future plans

The courses of OpenHPI are targeted both a general audience and towards IT professionals. For the general audience they seek to introduce the foundations of information technology, e.g., the design and structure of the internet and the world wide web, the structure and operation of database systems or security in information technology. In interviews with key staff of OpenHPI it became evident that this objective relates to a desire to improve public understanding in the field of IT and to provide a broader public with the knowledge to consider the possibility of a career in the IT field. It thus fulfils a public engagement and LLL role, and can be conceptualised at least to some extent within conceptions of community engagement as elucidated in a forthcoming publication by Benneworth and Osborne (2013) for the Global University Network for Innovation (GUNI). Furthermore in Germany LLL and CPD have not been historically strongly connected with the work of universities, which are not incentivised in this area, and here OpenHPI fills a gap. MOOCs open up a new way of accessing learning.

For ICT professionals the purpose is to offer courses that allow them to keep up with the very latest innovations in computer science research, e.g., In-Memory Data Management, the Semantic Web, or Multicore and Cloud Computing.

A further and less explicit public reason for engaging in MOOC work is the research interest of HPI in e-learning and tailored teaching. HPI is the highest ranked IT Institute in Germany, and a core part of their research aims are to improve the use of technology for learning. Through involvement in MOOC work a huge database of information about behaviours in online environments is gained, and this is being fed into research thinking.

The intention is to offer further provision across a similar spectrum of provision from the latest technology to more popular topics. Thus OpenHPI aims to target a broad audience and will do so both through the medium of English and German.

OpenHPI offers a solid platform for other users, and it was established in interviews that it has already sold the use of the platform to the company SAP (the company that funds HPI) to support its MOOC work, and there are also discussions with the French Research network, INREA, a large local hospital and requests from US hospitals. OpenHPI may therefore develop further in this direction as an organisation.

OpenHPI might also create a spin-off company to become a software vendor or to provide advice on MOOC development.

Outcomes of the practice

The principal outcomes of OpenHPI have been the offering of the following four courses, data for which is shown in the table below:

Table 20: Outcomes of different practices

Practice	Enrolment rates	Completion rates
n-Memory Data Management (English)	13,126	2,137
Internetworking with TCP/IP (German)	9,891	1,635
Semantic Web Technologies (English)	5,692	784
Data management with SQL (German)	na	na

A fifth course currently being offered is "WWW Technologies" (in German) by Prof. Dr. Christoph Meinel, which began on June 3, 2013. At the time of interviews (28 June) 6.5k had enrolled, with 2.5k still posting in week 4. It is suggested by OpenHPI that if individuals complete their second homework in week 2, this is a good predictor of completion.

In-Memory Data Management (in English) is planned for September/October 2013, led by Prof. Dr. Plattner and in November/December 2013, Business Process Technology (in English) will be led by Prof. Dr. Mathias Weske.

OpenHPI have undertaken some evaluation, most specifically of "Internetworking with TCP/IP" (the first xMOOC in the German language) (Grunewald *et al* 2013a). This gives some idea of profile. The majority of course participants belong to the 20-29 and 30-39 age groups (each approx. 30%). About 20% belong to the group from 40 to 49 and a remarkable high share of 16% comes from the silver surfers" group above 50 years. The remaining 4% are pupils of 19 years and younger. The youngest participant stated his age as being 12 and the oldest as 91. About 24% of the participants said that they had not been to university, 21% chose a BSc. as their highest degree, 25% an MSc. or equivalent and 4% had a PhD. The remaining 26% answered with "other" when asked for their highest degree. When asked about their ICT skills on registration some 6% reported having no experience, 32% declared themselves to be "beginners", 45% "advanced" and 17% "experts".

Funding of the initiative

OpenHPI is funded as part of the Hasso Plattner Institute (HPI), which in turn is funded by SAP AG, the world's largest maker of business management software. Hasso Plattner, one of its founders, owns 10% of SAP worth an estimated €7.1bn according to the Bloomberg Billionaires index. He is personally very committed to the initiative. This information alone provides a quite interesting context for the initiative since it is not dependent, in its early days, on generating an income stream. As a result it is an offer that is completely free to students, and its intention is to remain as such. Hasso Plattner has funded the foundation from his private assets for the day-to-day running of the Institute for more than 20 years.

However there are potential income streams from selling its platform to other providers of MOOCs and to offer advice to other providers.

A2: Understanding of the context

The context in which the practice is developed (institutional, geographic, regulatory)

Geographically, OpenHPI is located at the University of Potsdam, Germany within the Federal State of Brandenburg in its own building in a campus setting on land provided by the state. In terms of its geographical spread it targets an audience all around the world, but given that it has offered courses in German as well as English, it targets the German-speaking world and German diaspora.

OpenHPI is a development of Hasso Plattner Institute (HPI) based at the University of Potsdam in Germany. HPI is part of the university, but quite independent and effectively acts as a private institution within a public body. It is in Germany an 'aninstitut', and legally is a public-private partnership with the legal status of a GmBH, a limited-liability company in Germany. The private partner is the Hasso Plattner Foundation for Software Systems Engineering, which is the administrative body responsible for the HPI and its only corporate member.

HPI has two executive bodies: the Foundation Council comprising between eight and ten members and the Board of Directors consisting of between four and six members. There is some influence on activities from the State of Brandenburg and the University of Potsdam, as part of executive decision-making, but HPI's activities are not regulated by either the state or the university's regulatory systems. It is thus able to engage in activities which would be more challenging to do inside the state-regulated university system of Germany. However, its academic staff hold positions at the university and it contributes programmes to the university from bachelor to doctoral level, many of which are considered to be elite and highly selective in their choice of students. The programmes that it delivers to the mainstream provide the basis for OpenHPI.

There is a very strong technological and research context for OpenHPI since HPI has created a number of its own tools related to the delivery of e-learning. This creates an infrastructure that allows the delivery of MOOCs and analysis of impact without reliance on external input. This includes the following:

- The tele-TASK system which is described as a cost-efficient and simple way of recording of lectures and their dissemination via a modern portal enhanced with a semantic search and social collaboration (http://tele-task.de/)
- Tele-Board allows creative collaborative work in virtual, globally distributed teams (http://tele-board.com/)
- The Tele-Lab Internet Security, which is used in teaching. Participants have the opportunity to gain access to virtual computer and network environments via the internet, as they learn about and apply security technologies (https://tele-lab.org)
- The Semantic Media Explorer (SEMEX), which enables semantic search in multimedia data. Data is automatically processed and semantically analysed in advance (mehr Informationen)
- Blog Intelligence allows an efficient analysis of the exponentially growing amount of data in social networks and the blogosphere (http://blog-intelligence.com)

A3: Challenges and identification of the specific drivers behind the innovation initiative

The challenges that the initiative aims to address

It is not obvious that this initiative is seeking to address the conventional challenges being faced by HEIs of global competitiveness, the demands of students and other consumers for new services, internal requirements or changes in funding regimes. This is because it is not a university initiative *per se*. It is not seeking to recruit students for the University of Potsdam.

Nonetheless, there is potential spin-off effect in terms of profile for the University. In 2012, the president of the German Academic Exchange Service (DAAD), Prof. Margret Wintermantel, announced plans to improve the attractiveness of German universities to international students. Those HEIs that were prepared to develop new internationally oriented programmes and, in so doing attract overseas students would be provided with additional funds. Her logic in this statement was as follows: *"Winning over foreign students is how we will make friends and partners for the future. What is more, if we fail to increase the number of international students in Germany, we will be unable to maintain our academic system's excellence in light of demographic changes."* (https://www.daad.de/portrait/presse/pressemitteilungen/2012/19484.en.html).

She also argues that to attract the best students to Germany would also require making university admissions more straightforward and more flexible and better oriented towards the students' individual qualifications.

Whilst this is a potential context for this initiative, it is not this area that is made explicit. The challenges that have been stated by OpenHPI relate to a public engagement and public understanding role, to fulfilling LLL and CPD objectives of professionals. In Germany as in other parts of Europe, as reported by Federal Ministry of Education and Research (BMBF), *"there is a general consensus in the education policy discussion regarding the need for and the significance of continuing academic education. The existing and increasing challenges of demographic change, of technological development and international competition, the growing need for highly qualified personnel as well as the avoidance of social conflicts demand that people living in Germany should have the highest possible educational attainments. And these attainments must be constantly updated and adapted to new tasks and changing framework conditions in industry, technology and law." (http://www.bmbf.de/en/349.php)*

This is the LLL rhetoric that has existed over at least two decades. So whilst OpenHPI is at least in part working to that agenda, its provision is not as yet conceptualised directly as part of the University of Potsdam's contribution in that field. However that potential may exist.

The immediate cause for developing the initiative

The immediate purpose for developing the initiative is aside from providing this LLL and public engagement role is to fulfil HPI own research agenda. Through OpenHPI, the Institute will not only utilise its tools and the previous insights that it has gained through research, but will seek to develop new knowledge with regard to learning processes that occur through this medium. There will thus be a flow back into its research work. The HPI team specifically speaks about the following areas of research on OpenHPI:

- Analytics: What conclusions can be drawn from an analysis of learners' behavior? How can these conclusions be used to improve the online learning offer?
- Semantic and Social Web: What new semantic and social web technologies can be developed to support the understanding of and navigation in online learning materials?
- Virtual Learning Labs: How can environments where learners interact with virtual IT systems be made scalable for massive participation?
- Gamification: How can the motivation of learners be increased through the functionality and design principles found in computer gaming?
- Innovative Learning Services: How can learning be promoted in the heterogeneous context of where participants live and work?

Part B: The higher education innovation system: functions, components and relationships

In part 2, the case will be studied along the lines of the higher education innovation system: functions, components and relationships.

B1: Analysis of the functions

The function to which the innovation is related

The practices of OpenHPI relate to teaching, research and third mission. There is a substantial history to how OpenHPI has developed to its current position.

The chair currently held by Prof. Dr. Christoph Meinel has a history of some 10 years in developing various IT systems for innovation in tailored university teaching. Prior to OpenHPI it had self-designed a mobile system, tele-TASK, for recording, internet-broadcasting, and was one of the first European universities involved in podcasting lectures using iTunesU. Its web-portal www.tele-task.de has more than 4.000 tele-lectures and embeds powerful navigation and annotation tools. Tele-task is embedded into OpenHPI, and OpenHPI was developed with the advantage of experience with:

- Large-scale video streaming
- Capacity to edit lectures
- A player technology (this existing player was used in the OpenHPI platform)

Meinel early on in his career spoke about understanding that traditional e-learning offers the wrong image and was reliant on students being autodidactic, which involves being strong and disciplined in study, staying close to the material. Most people he believes do not have this set of characteristics. MOOCs with their social media platforms, and their synchronicity overcome the problems of traditional approaches. Being time specific they bring a large mass of people together into a virtual learning community.

The pedagogical approach is quite traditional in the e-learning world. The courses are based on a re-working of materials that are delivered within the undergraduate curriculum. Lectures are recorded using the Teletask box and combined with slides into a seven-week programme. The courses could be described as CMOOCs, in the sense that underlying principles relate to the developing of a connected virtual community of practice based on co-construction of knowledge. The CMOOC is distinguished from the XMOOC, which is essentially largely led by the material provided online, and has little by way of interaction. The idea of connectivism can be traced back to principles that emerge from situated cognition and the work of the Russian psychologist Vygotsky (1978), and the idea of a community of practice, a term made popular by Lave and Wenger (1991, p.98). Hung and Chen's (2001) principles of design for e-learning of *commonality*, *situatedness*, *interdependency*, and *infrastructure* are based on principles that emerge from these theoretical frameworks.

OpenHPI speaks about the creation of 'lively discussion forums and virtual learning groups' that 'encourage a stimulating exchange of questions and a collaborative learning of the subject' around the lectures and slides. Work is assessed via multiple choice and patterned questions and self-test quizzes, and a Certificate of Completion is given. Overall assessment is 50% through continuous assessment through such tests and 50% through an end of course examination. In both cases, participants have a one-week window within which to initiate assessment, and thereafter a strict time period to complete it. The five or ten best students in a course are identified as an incentive. The Certificate has the merit of being a signalling device; it proves that participants have an interest in continuing education, their interest in the topic and their staying power.

As previously indicated the initiative relates also to research, although up to this point the research potential has not yet been fully realised. In an initial interview, Christian Willems spoke in terms of the work in part being a 'research experiment' and that there would be considerable data gathering related to the merits of design features of the courses. One of the reasons for engaging in MOOC work is the research interest of HPI in e-learning and tailored teaching. HPI is the highest ranked IT Institute in Germany, and a core research aim is to improve the use of technology for learning.

Also as previously indicated there is a third mission element to OpenHPI in as much as its focus is **not** on traditional university audiences. It seeks a broad audience, making a contribution to schools, colleges, CPD and LLL. It is part of the democratisation of access to higher-level learning.

Impact of the innovation on other functions

HPI is a university institute with both teaching and research functions. It involves its graduate students in the work since they know the technology and they are not a costly resource for supporting the course.

There is a strong link made between research and pedagogical practice. Research knowledge developed over some years has been translated into the design of programmes. The Tele-task box was developed in the 1990s and has been refined since. It is a portable device that can be used to record lectures and incorporates slides. It is fundamental to developing the material on the OpenHPI platform. Experiments have been carried out by HPI to determine the value of video – it creates attention, and following a lecture is important because later discussions revolve around the lecture. These discussions are seen as important in the delivery model, and the capability to facilitate these interchanges has been a challenge for those working in online environments. Meinel commented in interview that, based on his research, he knows that a certain mass of people are needed to create a 'viral' situation in a MOOC. Typically only 10% of participants are active, and ideally thousands of active participants are needed to produce an online comment every few minutes. We see pointers here to the importance of mass participation in creating the rich inter-changes that are needed to achieve long-anticipated goals of online learning to create co-constructing knowledge communities.

In interviews there was also a discussion of other pedagogical issues, in particular how to keep individuals on the platform. Two techniques are employed – *gamification* and creating a *social learning community*. The former refers to using game elements in a non-game context (examples in other contexts include 4Square and Stackoverflow). Rewards (points) are given for effort and to create peer pressure for others to similarly do so.

The link between research, teaching and a third mission is also explicit. The research environment of HPI has created hardware, software and a pedagogical approach that facilitates a learning environment that is accessible to a mass audience. Further analysis of participants is required in order to determine the role of these programmes in opening up higher education, but there is certainly an intention of doing so. There may be some cross-over in terms of research findings with the current EC-funded project on the topic of 'Opening up Higher Education to Adults' being co-ordinated by the Humboldt University in Berlin and the German Institute for Adult Education (DIE) in Germany. (http://www.erziehungswissenschaften.hu-berlin.de/hsf/projekte/head)

B2: Analysis of the components

Identification and description of actors involved

There is a development team for OpenHPI at HPI within its Department of "Internet Technologies and Systems", led by Prof. Dr. Christoph Meinel, who is CEO and Scientific Director. Christian Willems is Head of the Technology Team and now the Project Co-ordinator. The other stakeholders in this enterprise include individuals from the core team from HPI that have strong technical expertise in design of virtual environments. There is a development team within HPI within its Department of "Internet Technologies and Systems", led by Prof. Dr. Christoph Meinel who is CEO and Scientific Director of HPI. Christian Willems is Head of the Technology Team and the Project Co-ordinator.

The courses themselves are led by specific chair-holders within HPI and two-five teaching assistants, who are drawn from research staff of HPI, including doctoral students. HPI has ten departments each with chairs and so far three of these chairs had been involved in OpenHPI. Others will become involved.

SAP AG is an actor in as much as it is the company, the world's largest maker of business management software, that funds HPI. Hasso Plattner, one of its founders, owns 10% of SAP, is a professor within HPI and offered the first course in OpenHPI. Hasso Plattner is also on the council of Stanford University.

The University of Potsdam appears NOT to be a key stakeholder. Whilst it hosts HPI, validates degree programmes of HPI, has HPI board representatives and offers joint appointments for HPI's academic staff, it has little or no involvement in OpenHPI.

The Federal State of Brandenburg is an actor in as much as it provided the land upon which HPI buildings stand and it is represented on the board of HPI by its nominees.

One of the novel features of OpenHPI is that it is one of the few providers offering some of its MOOCs through the medium of German. Furthermore, in interview Christian Willems indicated that participants were not simply native speakers from Germany, Austria and Switzerland, and from the German diaspora around the world, but also included non-native speakers of German. It therefore is an initiative that plays a special role for German speakers in an otherwise largely English language-dominated MOOC world.

Implementation of the initiative

There are a number of starting points, but perhaps most important has been the fact that a flexible infrastructure exists that is independent of the bureaucracy of the university system. In short the head of HPI and its chairs are virtually autonomous from the University of Potsdam. They contribute to teaching and research, including offering both Masters (60 students) and PhD (120 students) programmes, but as an independent unit. Other than this commitment, there is autonomy.

Secondly, as indicated previously, HPI has created a number of its own tools related to the delivery of e-learning, which creates an infrastructure that allows the independent delivery of MOOCs without any reliance on the private sector, and to research their delivery. This includes the following the tele-TASK system, Tele-Board, Tele-Lab Internet Security, the Semantic Media Explorer (SEMEX) and Blog Intelligence.

Third, HPI reports that it is the strongest research institute of its kind in Germany, and it has ten chairs, each with specialist expertise. Each of these chairs has or will contribute to the development of MOOCs, support by their teams of research assistants and doctoral students. This creates substantial profile for OpenHPI.

Fourth OpenHPI has a strong advocate in the form of Hasso Plattner, who has been strongly influenced by Stanford's thinking on MOOCs. His personal commitment is manifested in his willingness to front the first MOOC in 2012 and he will do so again in 2013. His profile is such that this in itself probably attracts many students to OpenHPI.

There are no obvious barriers to the innovation that were determined in the course of undertaking the study.

Table 21: Actors/stakeholders, level of operation, roles and responsibilities and activities

Actor/stakeholder components	Level (macro, meso, micro)	Role/responsibility	Activity
SAP AG (Prof. Dr Hasso Plattner)	Macro, Meso and Micro	Financial Support Exec	Funding HPI Board member of HPI Fronting first (and other) MOOCs
Federal State of Brandenburg	Macro and Meso	Executive Advice	Provider of Land Board member of HPI
HPI	Meso and Micro	Management	Ensuring infrastructure is in place through CEO Technical Support using existing staff Design (using technical staff and research associates/PhD students) and delivery of courses (led by Chairs with extended teaching teams)
Students	Micro	Consumers	Engagement Feedback through questionnaires Research subjects

B3: Analysis of the relationships

The nature of the relationship

The relationships between the actors cannot be elucidated in any completeness since some aspects are clearly quite confidential. Given the funding and management structure of HPI then there will be some influence from its Foundation Council and its Board of Directors.

The Federal State of Brandenburg provides a plot of land near the Griebnitzsee, on which the building complexes of HPI and Potsdam University's Institute for Informatics were subsequently erected.

Cooperation between HPI and the University of Potsdam is regulated by a cooperation agreement. The students at HPI are enrolled at the university, which awards Bachelors, Masters and PhD degrees to those who have successfully completed their studies. There is no credit awarded however for the MOOCs. Most of the professors working at HPI have a joint appointment to the University of Potsdam. HPI is headed by a scientific and business director who is responsible for the day-to-day running of the institute. OpenHPI is one of a number of activities of HPI, but it does appear to be a major priority and is strongly influenced by its funder.

Changes in existing relationships

There do not appear at present to be substantial changes in the nature of existing relationships between stakeholders external to HPI as a result of the OpenHPI initiative. However there appear to be changes in internal academic requirements in HPI, where there is expectancy that each of the 10 chairs will contribute to heading up a MOOC with OpenHPI.

Furthermore, the development of MOOCs provides vehicles within which researchers in HPI can focus their interests and develop new lines of research. For example interesting research dimensions were discussed in interviews with researchers at HPI. There is capability for real-time analysis of behaviours in online environments. Based on previously exhibited behaviours and linked performance, advice can be given to others of paths to take. In short predictions can be made of the optimal learning path. This is illustrated in a recent internal paper (Grunewald *et al* 2013b) that explores the behaviour of students in one of the MOOC courses.

Impact of the relationships on the innovative practice

The relationship between the teaching and technical team, and students has been such that OpenHPI have been able to get good feedback (from over 40% of active participants of the course in question, numbering some 1,100 responses). Based on this experience of OpenHPI's, which was from the “Internetworking with TCP" course and its evaluative survey, their researchers have presented arguments for a future development of the xMOOC model that bridges the gap towards the cMOOC model.

They have concluded in a recent paper:

1. Learning materials could be enriched through concept maps and hypertextual links that allow diverging, learner-defined paths;
2. Hands-on exercises allow learners to feel personally involved in the problem domain through their active experimentation and to grasp the complex relations to their own concrete experience;
3. Group discussions that support awareness, and reward contributions, allow learners to feel responsible and to collaboratively strengthen the learning process and to provide richer perspectives for reflective observation Grunewald *et al* (2013a: 11).

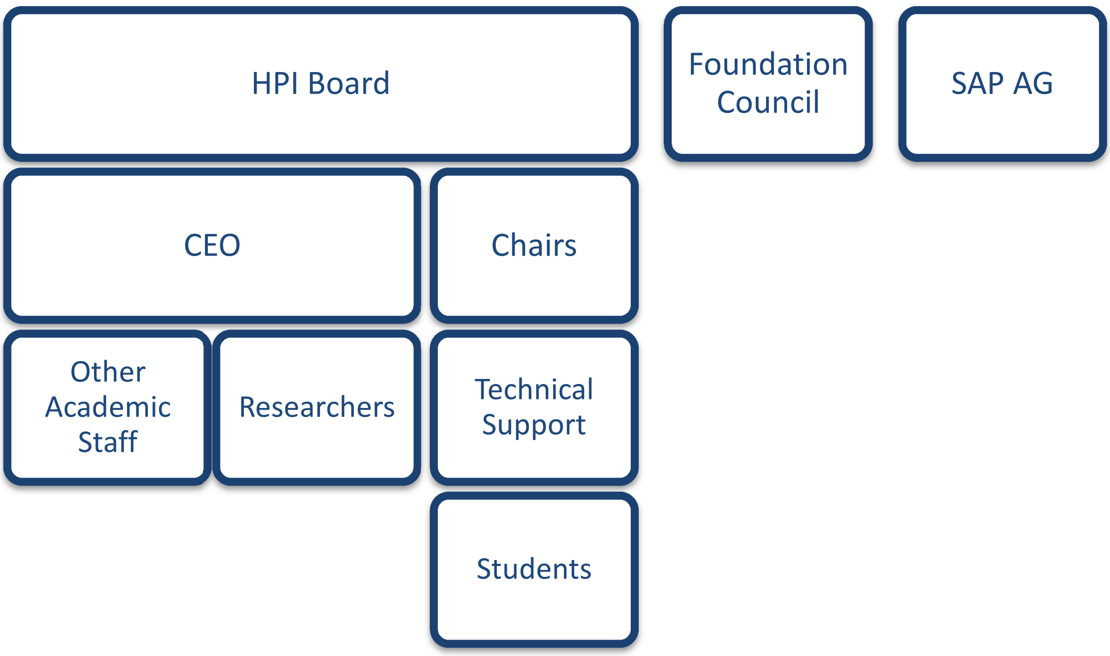
Table 22: Relationships between actors

Actor 1	Actor 2	Relationship	What changed?
Head of HPI	Chairs in HPI	Academic Leader for HPI as a whole, and role-model	Progressively each Chair is being encouraged to contribute to MOOC development, following the example of the Head of HPI and other key players, including Hasso Plattner
Teaching Associates and Designers	Students	Teaching Associates and Designers work in teams with a Chair, facilitate the learning process and seek evaluative feedback from student	Changes in pedagogical approach
Researchers	Students	Researchers evaluate online behaviours	Data feedback into the design of future courses

B4: Cross-elements analysis

Mapping the system and stakeholders

Figure 17: Mapping the higher education system for the case



Conclusions related to the innovation system map

The general direction of the innovation is steered by the Board and Foundation Council of HPI, and is supported financially by SAP AG. The Board has membership that includes the state government and the University of Potsdam, and therefore these bodies can advise on general direction.

HPI's CEO acts as the academic leader, in turn stimulating the other chairs within HPI to make contributions of programmes to OpenHPI. The chairs call upon other academic, technical and research support both to deliver material and to analyse the behaviours of learners in online environments. There is feedback obtained from students on the quality of the learning experience, which is fed into new developments.

It can be concluded that this is largely a top-down initiative whereby programmes are developed that are deemed to be of interest to both the general public and IT professionals, especially in the German-speaking world, and take-up indicates that this is the case. At a meso level staff members of HPI are given the opportunity to re-purpose their courses for online delivery, and from these efforts obtain considerable data for research as well as the satisfaction of making an offer to a new public. At the micro level students have the opportunity to give feedback on their experience and this is integrated into new developments. They also vicariously feed back into new development because their behaviours in the online platform are being analysed.

Part C: Outcomes, assessment and conclusions

In part 3 outcomes will be assessed and conclusions will be drawn.

C1: Conclusions: Assessment of outcomes in terms of expected and unexpected consequences

Barriers and bottlenecks

Many external observers would suggest that OpenHPI sits in a very fortunate position. It is a well-funded public-private partnership with a remit to carry out research, and with very stable funding from a generous benefactor. He is willing not only to provide funding, but also to commit his own time to the initiative, which is directly linked to the work of the multi-national company that he co-founded.

There are in the opinion of the director of HPI some limitations. Online MOOC provision will not be possible for all specialist courses of HPI. For example in the area of e-Security (virus creation and stopping), super-user rights within Virtual Labs are needed, and this technically cannot be achieved online with many students. This facility can only be used by between 30 and 50 students.

Some technical issues have also arisen, but have been overcome. The platform for OpenHPI courses had been designed to normally handle only 15,000 students. When, however, it was used as for a course offered by OpenSAP, some 30,000+ students were attracted, and the system crashed. This however has now been remedied to the long-term advantage of HPI.

Influence of the context on the success of the initiative

Contextual factors are important at HPI. As the public pronouncements of HPI state, Professor Hasso Plattner, co-founder of SAP and chairman of its supervisory board, maintains a high level of personal commitment to HPI. HPI is a private-public partnership with teaching designed to meet the needs of gifted young people who are looking for practice-oriented training as IT engineers. They are also in high-level academic research, which is directed at leading players in the business world. OpenHPI is a complement to the highly selective teaching environment and high-end research endeavours. It has a different orientation in as much as it is directed at both the general public and the continuing professional development of people in the industry, and at no cost. OpenHPI is therefore making a significant contribution in an area that has been identified by the German government as a priority, namely lifelong learning, and is able to do so with a nimbleness that is absent in mainstream German universities (and indeed the universities of many EU countries).

Outcomes and results

The outcomes of OpenHPI have been a series of high quality MOOCs in the niche IT area, each with high take-up. Amongst these some for the first time have been delivered in German. The have attracted a heterogeneous clientele in terms of age and previous experience in the field of IT, having been directed both at novices in the general public and professionals for knowledge updating purposes.

There has been considerable evaluation of initial courses from a student perspective. In addition to the papers of Grünewald et al (2013a and b). The first of these papers showed that respondents expressed a high degree of satisfaction with course content and structure, although the authors note the possible bias of the result, since the sample was only of active participants, and not the majority who did not continue the course. Respondents were also able to give open response feedback and recommendations for improvement to the platform and content – these recommendations are being addressed in future courses. It also produces guidelines for MOOCs for supporting experiential learning based on Kolb's (1984) model.

In the second paper, Grünewald et al (2013b) assesses the behaviour of the students in the online environment, and offers a typology of five types of participant correlated to levels of participation using Fishcher's (2011) model as developed by Dick and Zietz (2011).

In a further paper (Willems, Jasper, and Meinel 2013), OpenHPI report on an experiment with three practical tasks that were implemented as assessed bonus exercises. This study showed that graded hands-on assignments for their MOOCs can be provided without the need for major adoptions to the learning platform and without the provision of a resource-intensive centralised training environment infrastructure.

These are concrete research results related to pedagogical and design issues related to MOOCs that may have general application for other providers.

Transferability

The model that has been developed is transferable to other universities if there is a willingness to invest. Although OpenHPI enjoys the advantage of private sector funding and autonomy, what they offer is within the grasp of other universities in technical and pedagogical terms. Many universities would have the capability of developing their own platform and expertise in designing and delivering online courses. The model that is being offered by OpenHPI is very robust and supported by a strong technical and academic infrastructure. However, the pedagogical framework is not particularly radical.

OpenHPI is not however seeking to generate a surplus or attract high-fee paying international students. Its role is opening up the discipline to a wider audience in the spirit of LLL and in return it gets access to a massive sample of research data. There may then be spill-over effects for the University of Potsdam since it will be identified with a popular and high quality niche offer. If other universities want to replicate this model, then as its Director has said, this is not difficult to do. In interview, Prof. Dr. Meinel suggests that MOOC models such as Coursera are good for professors to market themselves, but not for universities since it does not highlight their distinctiveness. The development of platforms is not technically difficult, but it does require development time, and this might be a price worth paying to highlight the work of a particular university as against a consortium.

Annex D5

Case 3: Leuphana Digital School

Introduction / definition of the innovation initiative

Leuphana is a public university in Northern Germany and it has utilised the brand of the Leuphana Digital School as a platform for its online education.

In January 2013, Leuphana University launched its first MOOC (albeit on a small scale with 2,500 students) with the prototype course *ThinkTank – Ideal City of the 21st Century*, a 'free' (a nominal fee of €20 was charged for the certificate for successful completion at the end of the course) academic platform that offered collaborative web-based learning led by distinguished scholars and experts. This new program was described as 'a fresh, unique approach to collaborative learning – a university project open to participants from all over the world, regardless of where they live and what they do'. The premise of the course offered was that more than three billion more people will be moving into cities over the next 40 years, and that new models for living need to be considered.

Course Model

Participants worked in small teams to design models for future living in urban centres under the overall direction of the course leader, the well-known architect Professor Daniel Libeskind. They worked to solve theoretical and practical assignments, critique the work of the other groups through commentary and evaluation, and translate their ideas of the ideal city into a final visualisation.

Teams were purposely constructed with heterogeneous members from a range of different backgrounds, ages and geographic locations. These teams worked together to complete six assignments over some four months. Each team consisted of five students, and each of the some 40 volunteer professors (which included staff of the university and many tutors from outside the university from all parts of the world) took charge of some 10 tutor groups. Throughout the course, video lectures and reading assignments from the team of professors and guest lecturers were provided to help the participants deepen their knowledge of topics and aid in completing the assignments. Tutors were supported by mentors who provided teaching input, led classroom discussions and participated in evaluation of all final submissions. Teams were re-shuffled during the programme with students being given the choice of joining new teams.

Tutors supervised related groups and their team pages, monitored the submitted reports and the performance of each group, and assisted in evaluating the final submissions. It was therefore a substantial commitment for all concerned with tutors having to go online almost each day to respond to students.

Each assignment had two deadlines – one for the Peer Review, after which all participants were asked to give feedback on other teams´ solutions, and one final deadline before which teams submitted their assignments. Communication between participants took place on the online platform's different forums (each with individual topics) as well as a messaging system, which enabled participants to communicate with their peers and teachers. Throughout the course, Leuphana provided video lectures and reading assignments from its large team of professors and guest lecturers to help the participants deepen their knowledge of the topics and aid in completing the assignments.

Essentially what was being provided was a costly 'severe mentoring' and tutorial platform that was very highly supported by staff of the university and external collaborators offering their service for free. It was based on a strong constructivist model within which knowledge was co-created by student participants, and furthermore introduced the more radical notion of peer assessment. However, it also had a strong didactic element and in that sense could be described as 'blended'. It was referred to by the Vice-President, Holm Keller in interview as 'a playing field to see if distance learning can work'.

Partners

Leuphana did not develop its own infrastructure but used a customed platform that was provided by Candena. Other partners included the Fraunhofer Institute. Overall the project was part of the Leuphana Innovation Incubator Lueneburg, supported itself by the EC. Overall the investment was relatively small at €30k, but this of course does not reflect real costs of internal and volunteer staff, key partners in the enterprise.

The Participants

Some 2,500 participants started and throughout the course the same number were involved, though some left and others joined. Some 12% of the cohort graduated having completed the six assignments, which gave them five ECTS points. There was large regional diversity within the group, with a number of participants who were Arab women and others from Equatorial Africa. Many of the participants were thought not to be genuine, but journalists and 'spies' from other universities, who were observing how the programme would work. Very few of Leuphana's own students participated, with only five or six in total involved.

The Purpose

There are a number of reasons why Leuphana has gone down this route.

- One objective is to provide an opportunity for overseas students to demonstrate capability prior to migration, and in that sense this is a contribution to offering LLL opportunities to such an audience
- A second is to determine conditions by which credit can be offered for other programmes that might be brought to the university as part of ECTS. In short the university wanted to determine what the conditions for a quality course in this mode might require.

It is also instructive to determine why so many external tutors might be willing to be involved without any reward. It was speculated during interview that there are a number of reasons:

- At the most basic level individuals were interested in how a MOOC might work in practice and in how they might contribute to its success
- They were also interested themselves in meeting virtually with other tutors and with students around the world, some of whom might be suitable interns in the future. So part of the motivation was talent spotting.
- Finally it was a relatively convenient way to make a contribution to teaching since it did not involve any inconvenient travel.

For many tutors who were involved it was a better experience than the classroom with a much richer set of learning interactions.

Challenges

The principal challenge that was being addressed was to provide high quality online opportunities and to do so for those who traditionally cannot participate in higher education, particularly those from outside Europe.

As with all courses that are offered online, fraud must be controlled. A fear is that participants are not who they say they are. This was overcome by subjecting all assignments to peer assessment, which turned out to be more rigorous than that offered by the academics themselves.

The Future

As indicated above one of the reasons for following this route of offering a MOOC was to determine what the features of a quality mass online course might be. This is because from 2014 Leuphana intends to offer a Bachelor's which gives the possibility to award up to 100% credit from other programmes, and to direct this programme at the top 5% of entrants. Amongst the possibilities will be the ability to integrate MOOC provision from elsewhere into this accredited Bachelors programmes. Hence Leuphana will have developed a protocol for acceptance of credit. Already Leuphana accepts on average between 10-15% of portable credit from other programmes, but this will be a radical departure. It expects to be able to recruit a new type of student by offering this new degree, one that is willing to take risks and be innovative themselves.

Leuphana considers that it can play in this field if it has experience of running MOOCs. Of interest is that an investment company wanted to purchase the programme, and approaches were made by a global dating company to buy it.

2. Case study data collection guidelines

Data collection format: case studies
Case/ name innovative practice: <<insert text>>
Author: <<insert text>>

Key findings:

Please provide in bullet-points an overview of the key findings of the in-depth case study, covering all aspects of the case study (NB: the key findings will be drafted in the final stage of conducting the case study) (max. 0.5 page):

- <<insert text>>
- <<insert text>>

Part A: Setting the scene: introduction, challenges and contexts

A1) Introduction / definition of the innovation initiative

Please introduce the case, i.e. describe in general terms what the case is about and how it is situated in a broader context (NB: the introduction will be drafted in the final stage of conducting the case study). Please take into account the following items in describing the initiative:

- Q1: What are the overall objectives of the initiative? (Please consider formal/official objectives, as well as any informal objectives). Are there future plans, and if so, please specify.
- Q2: What are/were the outcomes of the practice to date?
- Q3: How is the initiative funded? (Does it cost or save money? If funding is limited to a specific timeframe, will or how will the initiative continue after funds are withdrawn?)

Max. 2 pages

Overall objectives of the initiative and future plans (Q1)
<<insert text>>

Outcomes of the practice (Q2)
<<insert text>>

Funding of the initiative (Q3)
<<insert text>>

A2: Understanding of the context

The context of an innovative practice is highly relevant in, firstly, understanding the practice and secondly, transferring innovative practices to other contexts (i.e. other institutions). This is why it is important to focus on the contextual factors when writing a case study report. This may be at the geographical level (is the initiative operating at an international, regional or national level?); at the institutional level (is the initiative driven or supported by a particular institutional set-up or partnership? What, if any, issues of

governance surround the initiative?); at regulatory level (are there particular (dis-)incentives to the initiative stemming from the regulatory context it is embedded in?); at a technological level (what technological resources were available at the HEI or are created through the initiative?).
 	
Please take into account the following items in describing the initiative:
– Q3: The context in which the practice is developed (institutional, geographic, regulatory, technological)
  – What is the geographical context within which the initiative operates?
  – What is the institutional context within which the initiative operates?
  – What is the regulatory context within which the initiative operates? (Where applicable, this should cover all the countries the initiative operates in.)
  – What, if any, is the technological context within which the initiative operates?

Max. 2 pages

The context in which the practice is developed (institutional, geographic, regulatory) (Q4)

<<insert text>>

A3: Challenges and identification of the specific drivers behind the innovation initiative

In the literature review a broad range of challenges stemming from the wider context, system changes, institutional setting, is identified. However, for each individual innovative practice a more detailed account should be provided on specific challenges this initiative was facing. Only having a clear idea about the precise challenge as a driver, will enable us to fully understand the innovative practice and the choices made in order to establish this practice. Already in the ToR (and hence in the selection of cases), choices have been made with regard to what types of challenges the study will focus on, e.g. disruptive technologies, new providers, global demand. *Please take into account the following items in describing the initiative:* – Q4: The challenges that the initiative aims to address (with a reference to the four broad categories sketched out earlier but focussing on the concrete and specific challenge that the initiative aims to address) – Q5: What was the immediate cause for developing the initiative?
Max. 2 pages

The challenges that the initiative aims to address (Q5)

<<insert text>>

The immediate cause for developing the initiative (Q6)

<<insert text>>

Part B: The higher education innovation system: functions, components and relationships

In part 2, the case will be studied along the lines of the Higher education innovation system: components, functions and relationships.

B1: Analysis of the functions

The function is closely related to the nature of the innovative practice. In general, the focus is on innovation in the deliverance and organisation of higher education courses or content. However, the function to which the case is related needs to be further specified. For instance, is it related to delivery, tracking, assessment, mobility etc? The following functions can be distinguished: – *A) Education (sub-functions include teaching and learning, curriculum development, assessment, student mobility and accreditation.)* – *B) Research (sub-functions include new knowledge creation, testing and measurements, experimentation, validation, dissemination of results, etc.)* – *C) 'Third mission' (sub-functions include human resources, intellectual property, creation of spin-offs, contracts with industry, contracts with public bodies, participation in policy-making, involvement in social and cultural life, and public understanding of science (Schoenet al 2006 cited in Laredo 2007).* *Please take into account the following items in describing the initiative:* – Q1: To which sub-function is the innovation related? Which previous functions and sub-functions does the practice substitute / enhance / improve / modify / etc? – Q2: Which other sub-functions are affected by the innovation? (If more than one, please rank them and provide short description of the magnitude of their impact.) – Q3: Does the innovation practice introduce a new practice or does it reform/improve an existing practice?
Max. 2 pages

The function to which the innovation is related (Q1)
<<insert text>>

Impact of the innovation on other functions (Q2)

<<insert text>>

B2: Analysis of the components

Every initiative is shaped by particular components. In order to understand the reasoning and rationale behind the launch of a particular initiative, the case studies will thoroughly assess how a wide-range of actors (direct and indirect stakeholders) have shaped and influenced the innovation initiative. As we saw there are individual, institutional and additional actors shaping the innovation practice. The study will look into their role, responsibilities, and activities undertaken in relation to the innovation practice. It could be the case that particular actors play a negative role, and hampered the implementation of the innovation; hence within the component analysis, barriers for innovation can be identified. *Please take into account the following items in describing the initiative:* – Q3: Identify and describe actors involved: – Who are the main actors that drive the initiative? Who are the actors that are affected by it? – Q4: How has the initiative been implemented? Which actions have been

taken? – What is the role of the different actors? – What is the responsibility of the different actors? – Which activities have been conducted by the actors in relation to the innovation initiative? *Provide an overview table.*
Max. 2 pages

Identification and description of actors involved (Q3)
<<insert text>>

Implementation of the initiative (Q4)
<<insert text>>

Actor/stakeholder components	***Level (macro, meso, micro)***	***Role/responsibility***	***Activity***
<<insert text>>	<<insert text>>	<<insert text>>	<<insert text>>

B3: Analysis of the relationships

Actors, either individual, or institutional actors do not operate in isolation, but in a complex network of surrounding actors, with which different types of relationships exist. As we saw, innovations can depend on new emerging relationships between different actors, between individuals, institutions, different levels and different sectors. Theoretical models, such as the Triple-Helix model, explain innovative power in terms of relationships crossing institutional boundaries. The case studies will analyse closely the relationship between all involved actors and assesses their impact on the emerging of the innovative practice. *Please take into account the following items in describing the initiative:* – Q5: What is the nature of the relationship in terms of costs and benefits (financial and non-financial) that affect the different actors involved? – Q6: What relationships and dynamics among actors are intensified by the initiative (e.g. collaboration / conflict, substitution, networking)? – Q7: What is the impact of these different relationships on the innovation practice? Which relationships can be improved, hamper the practice, etc.? *Provide an overview table.*
Max. 2 pages

The nature of the relationship (Q5)
<<insert text>>

Changes in existing relationships (Q6)
<<insert text>>

Impact of the relationships on the innovative practice (Q7)
<<insert text>>

Actor 1	***Actor 2***	***Relationship (Q5)***	***What changed? (Q6)***
<<insert text>>	<<insert text>>	<<insert text>>	<<insert text>>

B4: Cross-elements analysis

Through mapping context, challenges, components, relationships and function related to the innovation practice, for each of the cases an innovation system map can be produced.
 	
– Q8: Position the actors in the scheme and draw lines expressing relationships between the components.
– Q9: Draw conclusions on the basis of the map
  – Which interesting findings can be determined from the schematic overview:
  – Is there a bottom-up or top-down approach?
  – How do authority-lines run (vertically or horizontally)?
  – How does the initiative have an impact on different actors?
  – What is the role of beneficiaries (consumers and/or drivers)?

Max. 2 pages

Mapping the system and stakeholders (Q8)
<<insert text>>
What are the major stakeholders and how do they interact?

Conclusions related to the innovation system map (Q9)
<<insert text>>

Part C: Outcomes, assessment and conclusions

In part 3 outcomes will be assessed and conclusions will be drawn.

C1: Conclusions: Assessment of outcomes in terms of expected and unexpected consequences

Depending on the maturity of the innovative practice, results (either expected or unexpected) can be identified. The results can be related to the function and the aim of the practice; but the practice can also affect the separate components and the relationships that exist between them. In addition, bottlenecks and barriers will be identified, related and lessons will be drawn from this.
 	
Please take into account the following questions with regard to the outcomes and results:
– Q1: Barriers and bottlenecks
  – What are the main barriers to the implementation?
  – Where are the main bottlenecks for the initiative?
– Q2: Influence of the context on the success of the initiative

- what contextual factors enhance the success of the initiative?
- what contextual factors inhibit the success of the initiative?
- Q2: Outcomes and results
  - Can you name the main outcomes (intended and unintended) that stem from the initiative?
  - Has there been an impact assessment or evaluation of the initiative?
  - Analysis based on the themes mentioned above and on the answers to the questions.
- Q3: Transferability
  - What can others learn from this particular initiative?
  - To what extent is the initiative transferable to other situations? And what contextual conditions should hold true in order to do so?

Max. 2 pages

Barriers and bottlenecks (Q1)
<<insert text>>

Influence of the context on the success of the initiative (Q2)
<<insert text>>

Outcomes and results (Q3)
<<insert text>>

Transferability (Q4)
<<insert text>>

Part D: Annexes

D1: List of literature used

In making references please follow common guidelines:
- For books, policy documents and studies:
  Name, A. [or organisation] (Year), *Title*: website
  Example: CEDEFOP (2011), The development of national qualifications frameworks in Europe.
- For articles:
  Name, A. (Year), Title article, *Title journal*, vol @@, issue@.
  Example: Broek, S.D., Buiskool, B.J. (2012), Mapping and comparing mobilisation strategies throughout Europe: Towards making lifelong learning a reality, *Journal of Adult and Continuing Education*, 2012, Vol 18, 1.
- For websites:
  Organisation: www.@@.@@
- Please, **never** use “Ibid”, “idem” etc. but **use full references** since texts might be put in another order and references might in that case get lost.

<<Insert text>>

D2: List of persons contributed to the case study

This includes interviewees, and persons providing information otherwise.
Please mention:
- Name (Mr/Ms, forename, surname (title))

- Function and organisation (first own language, than the English translation)

Please ask whether the interviewee agree that his/her name will be included in the final publication

Name	Organisation	Country
<<Insert text>>	<<Insert text>>	<<Insert text>>

D3: Additional annexes (documentation, survey results, interview reports, etc.)

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Study on Innovation in Higher Education

This document contains:

- Executive Summary of the Report
- Final Report of the Study on Innovation in Higher Education
- Annexes to the Study

Education and Training