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## **Engaging micro and small sized companies in European high-tech innovation based on**

### **Open Knowledge and Distributed Learning**

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## **Introduction**

To strengthen small and medium sized enterprises (SMEs) has continuously ranked high on the European policy and innovation agenda. However, the degree of integration of SMEs into European wide research initiatives is still small. This is particularly the case when enterprises of smallest scale are considered – in other words when the emphasis is on the “S” in SME. Building on the success of *micro-loan programs* in developing countries, recent movements have started in Europe to increase the focus on specific programmes aimed at micro to small-sized enterprises as a breeding ground for innovation and economic growth. But only few current high-tech innovation and research development initiatives meet the specific requirements of the smallest companies.

The Digital Business Ecosystem (DBE) project funded by the European Commission as part of the 6<sup>th</sup> Research Framework Programme has successfully demonstrated how an active community of around 300 SMEs – many of them micro-sized – can be launched in a high-tech area and has also demonstrated how European research activities can be linked directly to European regional development – spreading out to regions in Spain (Aragon, Extremadura), Finland (Tampere), UK (West Midlands), Ireland (Maynooth / Kildare), Germany (Baden Württemberg) and Italy (Trento, Piemonte). The DBE project has also led to sustained community activities supported by a cluster of continued research projects – funded by the European Commission - as well as to regional project activities supported further by European structural funds. This close integration of the levels of regional innovation policy, small sized companies as well as of European integrated research programmes – also involving leading industry players - is an interesting role model for a new way of innovation that could be of particular importance for Europe. It also provides a competitive approach - to classical ways of innovation diffusion or research results dissemination – that incorporates open knowledge creation and mutual learning on these different levels.

From a policy perspective the approach developed in the DBE project falls into the wider methodology paradigm of the Open Method of Coordination (OMC). It also shares several of its premises when it comes to fostering innovation in Europe (Borrás and Jacobsson, 2004) – most importantly:

- The integration of actions at various levels of governance enabling a better regional grounding and bottom-up emergence.
- The mobilization of a wide range of actors including public as well as private sector
- The explicit support for learning that encourages mutual co-operation, exchange of knowledge and mutual correction through peer governance.

Whereas OMC based policies already have had a wide impact on European policy, we propose that specific Open Knowledge and Distributed Learning (OKDL) based approaches can be derived within the larger OMC principles and more widely applied to engage multiple actors – including specifically micro to small sized companies – in community driven innovation processes.

## **Understand the playing field –needs of micro to small sized companies in the context of high-tech research projects**

Before exploring in more detail the OKDL approach that the DBE project has piloted, the playing field that the project addresses needs to be understood.

A closer look at the number distribution of European SMEs<sup>1</sup> reveals that 92% of them have indeed less than 10 employees. As an informal sector these represent 10 to 15% of the European GDP. An in depth analysis<sup>2</sup> conducted for the European Commission in 2001 revealed that particularly the micro to small SME sector would hold the highest potential of all SME segments for employment creation – once lock-in effects could be overcome.

These smallest enterprises are mostly found in either traditional individualized industry sectors – such as tourism – or in high tech sectors – such as IT - and high value services – such as consulting. Their natural focus is on being close to the market, agile, individualized and flexible – thereby often strongly relying on capabilities of individual key persons. Compared to that, traditional advantages of mid to larger sized enterprises have been the efficient organization of repeatable business processes and also the larger independence from individual key persons. In return, a central growth hurdle of the smallest companies is to scale-up their individual business. SME business ecosystems might provide a (virtual) alternative to larger organizations. To take an example, a well integrated ecosystem of small logistics services companies covering each a limited geographical area might realize similar integrated services than a large logistics company – e.g. delivering on a global scale.

To reach this integration, ICT – in other words the “D” in DBE - becomes a crucial enabler role. In the logistics example this would relate to integrated ordering, tracking of goods, handling- over in between partners etc.

Here, ICT technologies could make direct business sense for SMEs. However, the engagement in a related research activity leads to a typical case, where individual company interests (to increase future service possibilities and market reach) need to be balanced against direct costs of participation (e.g. with regard to maturity of the researched technologies, implementation costs, own technology capabilities etc.). This rather pragmatic utility balance consideration is typical for micro to small companies and too often this is the point where a possible participation in an innovative research project would stop - specifically also when administrative hurdles

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<sup>1</sup> Figures according to the European Microfinance Network based on economic research of the Observatory of European SMEs from 2003

<sup>2</sup> European Commission – DG Enterprise – „Innovative small and medium sized businesses and the creation of employment“, October 2001

– such as complicated consortium agreements and financial requirements – add to the costs of participation.

Another characteristic – particular when it comes to ICT research projects – is, that the use of state-of-the-art enterprise-ICT within the smallest companies such as for managing customer relationships, supplier connections or electronic invoicing is most often marginal. On the contrary, the use of the Internet for community communication and interaction is significantly growing. In the same way mobile communication technologies are intensively used for field work up to individuals doing freelance work (e-lancers). In that sense, micro to small companies are often both *disconnected* to some and *well-connected* to other ICT technological developments at the same time. In other words – their basis of adoption for any new ICT generation is significantly different from that of a larger enterprise that usually has a well developed legacy technology stack and that will consider to enter into all next generation technologies that it considers relevant. Once again, similar to what we know from technology adoption in developing countries (when countries e.g. adopt mobile phone technologies before even installing a fixed line network), micro to small sized companies often leapfrog technological developments when they are unsuited to their specific use requirements – even though they might be relevant for their general business area. In that sense, general business relevance is an important but not a sufficient criterion to get small companies engaged.

Coming back to the micro-loan analogy, this means that in order to make a high-tech development relevant for micro to small sized companies it also needs to be scalable and integrate-able in the use environment of these companies. That is particular important if any form of sustainability is to be reached – whereas by sustainability we mean that SMEs will continue their activities beyond the end of external funding. This also means that SMEs are able to take something out of the research project that they can sustainable manage themselves in the future. This puts specific demands not just on the methodology of engagement but also on the research project's technological focus as such.

## **Open Knowledge and technologies for micro to small sized companies**

The question of how well a research project's content is adapted to the needs of SMEs is directly connected to the issue of Open Knowledge. Given the fact that small sized companies will rarely be able to ensure participation along the entire scope of a complex research project – knowledge sharing and overall management of the integration process becomes crucial.

More specifically, the use of a hierarchical integration approach is rarely adequate to the needs of micro and small sized companies. The DBE project has made particular good experiences with applying Open Source development principles in its technology development. This has led to – apart from the better component reusability that springs from using an Open Licence – faster cycles of releases and communicating about new developments. It has also led to earlier exposure of project results and continuous feedback channels from the SME community to the core developing team.

Whereas a hierarchical approach would have led to a single major release derived from a series of integration rounds, the Open Source approach has provided a parallel component-wise development and sub-releases with a parallel thin layer of integration. That has allowed SMEs to choose from the range of technology infrastructure components that the project has produced those that fitted best their individual application needs.

In the same way as the development approach needs to allow for openness, the technology paradigms followed in the research project need as well to reflect this. The DBE project has therefore chosen paradigms such as the peer-to-peer (P2P) architecture for its middleware layer. Instead of a relying on a central instance, P2P has e.g. allowed to create autonomous sub networks that better reflected the SME community structure. In fact, SMEs have chosen to build applied DBE cases mainly with those network partners where they could build on already established business relationships. Here, the P2P architectural choice has also removed technical dependence from unknown and probably un-trusted partners in the wider community.

In that sense, Open Knowledge does not only relate to general open access to assets (such as concepts, deliverables, software pieces etc.) of a research project but to technological choices and development methodologies that allow SMEs a component-wise specialization and parallel leverage of overall integration benefits.

## **Distributed learning - an engagement methodology**

Similar characteristics of openness need also to be reflected in the engagement approach towards SMEs and in general community building. Here the DBE has successfully developed and piloted a distributed approach that builds on different *community roles* (figure 1) and distinct *community development phases* (figure 2).

The DBE community building was essentially driven by the interaction of the core project consortium with regional development or technology transfer organizations and SMEs. SMEs thereby took different roles in the community development process according to their ability and also willingness to provide contributions. Classifying these roles and acting differently on them turned out to be a very important component of the engagement approach. Other actors included regional policy makers, SME associations, Open Source bodies and similar influencers.

## **Differentiated community roles in the engagement process**

The following provides an overview on main roles and how the project consortium engaged them:

**Regional catalysts** shaped the nucleus of the DBE as they identified different types of SMEs via regional tenders that were shaped to the particular project engagement phase. They also conducted training and coaching activities and established contacts as well as managed the relationship to regional influencers such as policy makers.

**Drivers** were SMEs that had strong capabilities and interest to participate in the DBE at a very early stage. With a profound background in the relevant technological and business concepts they had a crucial role in establishing the

DBE community and absorbed the necessary DBE knowledge faster than other participants. Drivers received an intensive training and particular high effort of one-to-one interaction with core project members in the early phase. They also took over responsibility for training and dissemination to the growing community in later phases.

**Discoverers** were user SMEs that had limited technological capabilities. However, they were eager to test-drive DBE technological components with the implementation and development support of Driver SMEs. In that sense they were the early adopter group. Generally highly motivated, they provided the basis for the user community development. They also provided important feedback on usability questions. Contact to Discoverers was mainly managed indirectly through Driver SMEs.

**Implementers** were SMEs that entered the community at a later stage and that showed more limited motivation to engage in the project as active participants. Typically they concentrated on building application cases of limited scale – thereby integration **User SMEs**. Training and knowledge transfer to Implementers demanded more carefully worked out training material and well conducted training sessions of larger sizes. Implementers were particularly eager to limit the cost-side of their engagement and arrive fast at business relevant benefits.

**Policy Makers** - mainly official institutions and public institutions - supported the Regional Catalysts and provided a linkage to other regional development activities. Policy makers were contacted in individual meetings and through specifically tailored material that highlighted the economic potential and wider policy perspectives of the programme. Specifically, policy makers were interested to understand strategic fitness of the DBE initiative within the wider portfolio of regional development activities in the ICT domain. Here the project was in an active consulting role to help policy makers determine the strategic fitness and achieve a possible linkage to related programmes.



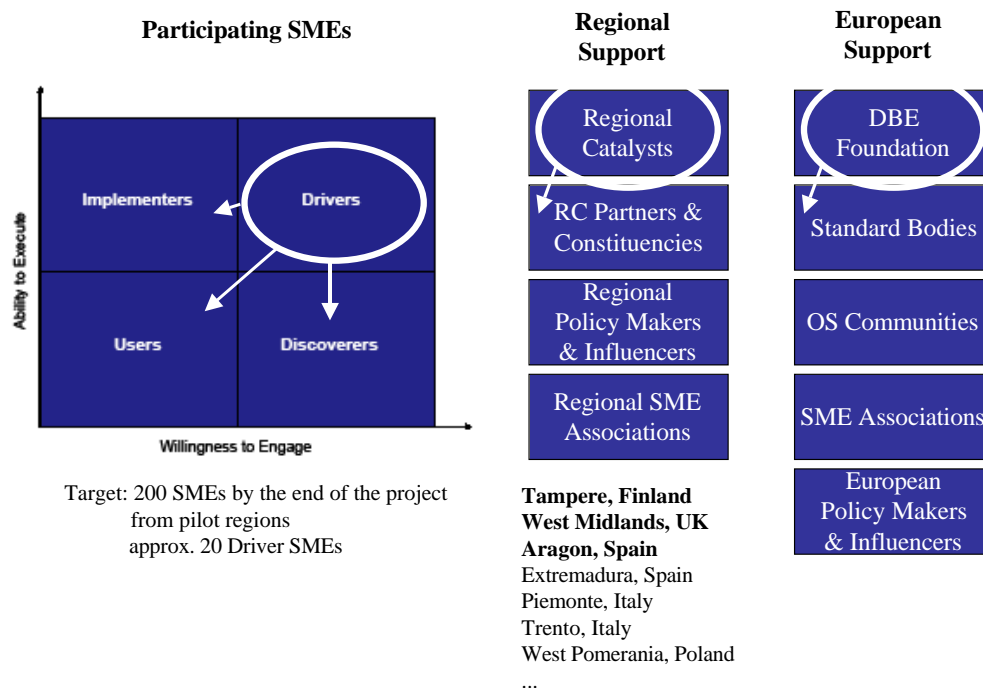


Figure 1: DBE Community Roles

Similar to the modularity and openness that has been explained for the technology development process, the interaction of the different community members and their different perspectives has been very important for community growth. The upfront incorporation of the differences in these community roles into our engagement methodology as well as into related actions such as differentiated communications and trainings has allowed that each actor quickly grew into their community role and provided optimal contribution. In that context not any of the perspectives has emerged as dominating the others.

## Engagement Phases

In addition to differentiating by community roles, the project has also successfully applied a differentiation by community development phases. Both the community roles and the development phases provide a basic framework that can be applied to similar high-tech community building scenarios.

In that sense, the engagement phases should also not be misunderstood as a precise plan to be executed in neat order. Instead they provide similar to the community roles a reference framework to assign and better shape community building activities. They can lead to a better understanding of community evolution and how different types of actions might support it.

It also needs to be mentioned that whereas overall characteristics were consistent, phase actions and timing have been further shaped to individual characteristics of a region and its regional SME environment. However, the model provides an integration level on top of community development activities in a range of rather different regions.

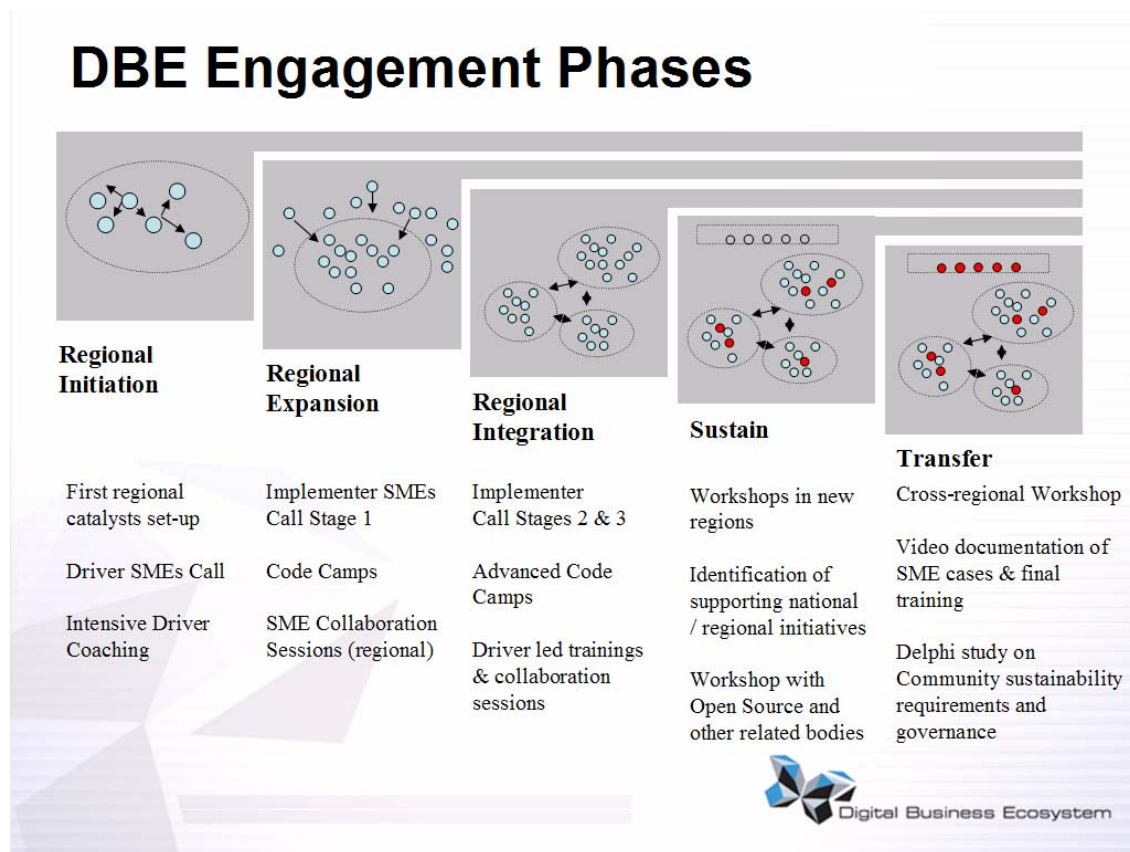


Figure 2: DBE Engagement Process

In the DBE project the phase model was applied as follows:

### ***Phase 1: Initiate local sub-communities***

In this initial phase the DBE project was in a push role, actively selecting, encouraging and enabling actors to join the DBE on a regional level. Driver SMEs were the first to be carefully selected by the Regional Catalysts and to become actively engaged for the initial DBE application domains / markets. The regional initiation phase used primarily face-to-face meetings and many one-to-one coaching sessions.

### ***Phase 2: Regional expansion***

In this phase, the DBE project changed from a strong push-approach to a facilitator role. Here independent interactions between the parties were actively encouraged and rewarded by the DBE project, with the aim to strengthen initial sub-communities of SMEs around the DBE technology and concept. The DBE project encouraged the initial actors to extend the communities in order to attract Implementer and User SMEs. In practical terms, this meant that implementers worked on joint application cases with pilot users and took part in so-called “Code Camps” which helped them install and configure DBE infrastructure. In addition, DBE Community building was supported by collaborative tools (such as Wikis and Blogs) and interactive training material.

### ***Phase 3: Regional integration***

In phase three, the project has conducted a series of roadshows and workshops in new regions as well as invited SMEs from different regions to a collaboration workshop. After two years of community building efforts it can be said that the DBE project clearly fostered the interaction between regional sub-communities, however the aim to build a strongly integrated cross-regional DBE community could only be partially achieved. Social network analysis that was conducted in parallel to community development showed that the overall DBE community that emerged out of phases 1 and 2 was still determined by social sub-networks that had existed prior to the project. We could observe that additional network links formed first based on proximity of community members – e.g. same region, similar business area. The process of wider community integration is a slow process and the project could certainly trigger this only to an embryonic stage.

### ***Phase 4: Sustain community actions***

Basic sustainability was achieved via regionally funded follow-up activities and further EU FP6 projects (e.g. the projects OPAALS, ONE or PEARDROP). In addition single pre-commercial application cases were developed – with several of them emerging into candidates for wider commercial adoption of the DBE technology through SMEs.

### ***Phase 5: Transfer - enable take-over and step-out***

A genuine transfer of responsibility to the DBE community turned out to be a major hurdle towards self-sustainability of the community. In this context, a number of self-driven activities by members of the SME community (e.g. JBoss, RedHat, Free Software Foundation Europe) provided an interesting opportunity to ensure both responsibility transfer and improved marketability of the DBE concepts and technological developments in the future. Mostly these take-over activities related to specific elements of the overall DBE approach. The JBoss Open Source community was e.g. particularly interested in a feature of the DBE infrastructure that provided independence from physical network addresses. This partial take-over attempts lead to direct questions about how to ensure future consistency of the community activities as well as to how to provide governance for this.

In summary, the engagement phase model has provided a very helpful navigation instrument throughout the project. In combination with the role differentiation it provides a framework to target activities very specifically. It also helps to determine blindspots in a community development approach.

## Incorporate different SME perspectives

Coming back to SMEs as central actors in our community development, it has been particular important to incorporate their different ambitions and business perspectives on the DBE initiative.

The following table provides an example of feedback that SME members of the DBE community gave in a regional networking workshop.

SME	Feedback example on the DBE initiative
Antonio Garcia Morte, CIERZO, Aragon Spain	<ul style="list-style-type: none"> <li>• The DBE provided the entire infrastructure so we were able to offer our mobile services for tourism.</li> <li>• The long term vision that the DBE proposes is very positive, although its high level of abstraction provides a set of problems in order to achieve concrete results in the short term.</li> <li>• The DBE platform has improved a lot during the last year (installation, stability, technical support of the Computing team, ...)</li> <li>• However, it still has some problems regarding complexity, stability, deployment, identity and security.</li> <li>• Personal summary: The DBE has to be strongly supported and pushed forward right now in order to get enough critical mass.</li> </ul>
David Munoz Garcia, Gabilos Software, Aragon Spain	<ul style="list-style-type: none"> <li>• With the DBE we were able to offer a real-time online service for wholesalers, travel agents and holiday homes</li> <li>• DBE Platform allows to integrate different language software applications.</li> <li>• All enterprises are represented in the same way and have the same opportunities.</li> <li>• The DBE offers new business channels for SMEs.</li> </ul>
Magnus Lindros, Sovibox, Tampere Finland	<ul style="list-style-type: none"> <li>• Our clients will get additional functionalities and business opportunities.</li> </ul>
Zaf Ghandi, Excellis Consulting, West Midlands, UK	<ul style="list-style-type: none"> <li>• The DBE is facilitating the shift to Service Oriented Architecture (SOA)</li> <li>• Facilitates vertical and horizontal integration of further services</li> <li>• Significant cost and time savings</li> <li>• SME mindshift with regard to ownership. You don't have to own a website in order to generate value.</li> </ul>

Table 1: Example feedback from SMEs by the end of the DBE initiative

These extracts from SME feedback show the interaction that SMEs had with the DBE technology infrastructure and concept on the one hand and their individual business interests and application fields on the other hand. This interaction has in fact been a major driver of the project and also of community development. It became clear that the knowledge capabilities of SME to assess and understand even complex high-

tech initiatives are often not the main limitation factor. More limitation factors are how modular the initiative is structured and how openly the interaction with SMEs is conducted.

This clearly speaks against policy programmes that aim mainly to *educate* or *advise* SMEs on the use of new technologies. In fact, the related capabilities of SMEs tend often to be underestimated. However, the general methodology approach of an innovation policy initiative – specifically with regard to openness, organization of integration, governance and community roles - can decide about how well suited it is for smallest companies or not.

Dealing with a larger group of SMEs in such an initiative makes particularly the integration of different perspectives, backgrounds and application contexts a challenge. It also challenges readymade assumptions about these.

The DBE project has also received significant steering through the SME community – e.g. when it came to clarifying DBE business potentials and application areas.

## Conclusions

Coming finally back to the initial question how well the approach taken in the DBE project can serve as a generic model for engaging micro and small sized companies in European high-tech innovation. We think it has strong potentials but the approach should not be misunderstood as a simple repeatable master plan.

Instead, we can draw the attention of particular factors that tend to be overlooked when it comes to engaging micro and small sized enterprises – especially in larger communities:

- The interaction with technological choices – specifically when it comes to issues of modularity and distribution in the technical architecture
- The importance of development processes that balance integration against open participation and avoidance of rigid hierarchical organizing
- The need to specifically care for different community actors, to understand their roles and to shape interaction, training, communication etc. with them accordingly
- The connected need to distribute community building efforts unequally and partially tactically
- The importance of using replication effects in the community – e.g. engaging users through software developers – that can build on pre-existing business and social networks in between SMEs
- The recognition of different phases of community development and the shaping of actions according to these phases.
- The importance of addressing sustainability and governance issues early on and as a continuous issues – without presenting readymade solutions
- The attention to timing – specifically with regard to parallel slower and faster growth processes in the community – e.g. a faster growth in size and a slow grow in community integration

When taken these points into consideration it becomes obvious that they transcend a research and innovation initiative from its very set-up phase to kick-off until end. In that sense, activities like “dissemination or diffusion” – usually placed in the final phase of projects become obsolete. The encouraging experiences from the DBE project provide strong evidence about the value of such an approach and can serve as a basis for related (re)shaping of future high-tech innovation and research projects.

If Europe is serious about the role of SMEs in European research, learnings from projects such as the DBE need also to be taken into account by policy makers shaping rules for project governance and outlines of research policy. This could lead to reconsider and remove structural barriers for the full participation of SMEs in research policy programmes such as the European Commission's framework programme.