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The role of institutions and IPR schemes in supporting intentional and unintentional knowledge sharing (CAM)

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Short Description:

Ch 1 looks at the categories of knowledge: notably knowledge with utility – know-how - which is perfected by practice, passed on by observation of practice, and frequently never recorded. It attempts to determine the reach of IPRs, and what knowledge types should or should not be exempt from creators' rights in them.

The rest of the deliverable comprises a practical report on the experiences of being a Regional Catalyst in two cities in the East of England.

Ch 2 defines the role of the Regional Catalyst, and reviews earlier work in Ireland, Aragon, and the West Midlands done by the DBE project. It analyses a variety of approaches that can be made to potential DE adopters and their relative merits. It makes recommendations for further directions to succeed in the role.

Ch 3 explores the *production of knowledge* in the Cambridge Technopole high technology industries, the *acceleration of knowledge transfer* across the Technopole, and strategies for *knowledge diffusion* beyond the Technopole. It points up the *pro-networking strategies* in the Technopole, and the ways it harvests social capital within the close-knit academic/entrepreneurial community, and generates new capital by dense networking activity in the intensifying entrepreneurial atmosphere fostered amongst the University students.

Ch 4 deals with the structures put in place through government intervention to support the environmental sector in Peterborough. It marks the number of *anti-networking effects* uncovered in Peterborough's recent development (many unintentional, nonetheless counter-productive).

All inquiries in this study have sought to determine a route through to establish a European model DE in one or more contexts in the cities studied.

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PART A A Theoretical Framework for Knowledge

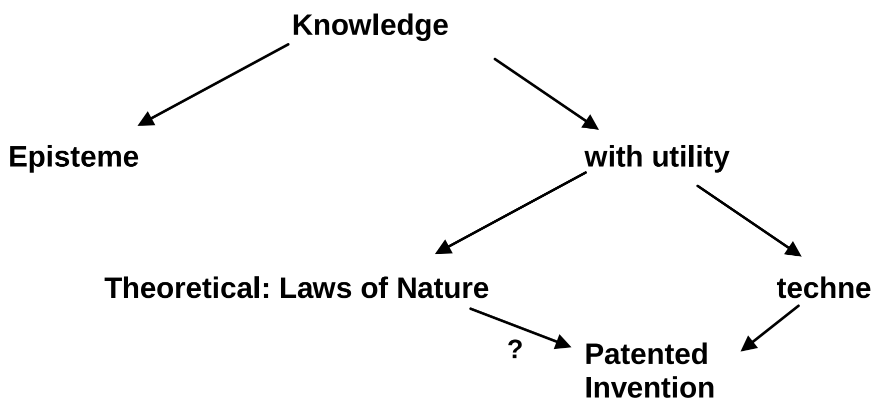
The first part of chapter 1 attempts to define the reach of IPRs, and what knowledge *types* may or may not be exempt from creators' rights in them.

Part B examines the historical justifications for having a patent system. It inquires whether there is a binary relationship between protected subject matter and that which has sedimented out into the *Public Domain*, and whether these two constructs between them consume all of intellectual space. It explores the notion of a *Commons*, and what the intellectual analogue of a (land) commons might be.

The discussion in chapter 1 prepares the reader for the reports in chapters 2 through 4 on the support structure for innovation in the Cambridge Technopole and the Innovation Centre for environmental industries in Peterborough.

The chapter should be seen as a formal work undertaken with a philosophical approach. The conclusion guides the proposed OPAALS Phase 3 study, and informs the policies adopted in the cities studied and reported on in chapters 2, 3, and 4

Part A Categories of Knowledge



This early part of the section takes a definitional and philosophical approach to the idea of what Knowledge might be, and what divisions of the field emerge across time. Most relevant to the discussion on rights in intellectual property is the distinction between cataloguing and explanatory knowledge on the one hand, and on the other, knowledge with immediate utility – know-how - which is perfected by practice, passed on by observation of practice, and frequently never recorded.

A.1. What is Knowledge?

Fritz Machlup discusses 15 dictionary meanings of knowledge[1]. He settles on the expression that it is '*anything known by somebody'*, and defines the *creation* of knowledge as 'when someone learns something new'. Knowledge is found in people's heads, so these containers of knowledge are evaluated as *human capital*[2]; and the creation of knowledge in people's heads (*knowledge production*) is an asset of the firm[3].

Bertrand Russell defines *social knowledge* as – 'what the community knows … in its *collective* capacity' as distinct from *individual knowledge*[4]. Individual knowledge may, of course be duplicated across a community, rendering the notion of 'social knowledge' redundant. Joel Mokyr chooses to formalise a notion of *aggregate knowledge*[5] (in the society) as the union set of all sets of knowledge in minds or storage devices, thereby eliminating the redundancy implicit in the concept of knowledge in a population.

Machlup makes the decision in Volume 1 of *Knowledge: Its Creation and Distribution* that '*knowledge'* shall refer to content, and *information* shall imply the process of dissemination[6]. Thus content *communicated* is information[7]. People can be poached to other firms for their *know-how,* but equally firms may exchange *codified* or *tacit information*, to mutual benefit[8]. In recent times this is perceived to be where related trade activities are co-located in a geographical cluster[9].

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1 *Knowledge: Its Production, Distribution and Economic Significance:* Vol 1 *Knowledge and Knowledge Production.* Fritz Machlup, [1980] Princeton, at p25. Hereinafter: *Knowledge.*

2 Likened by Adam Smith to 'those expensive machines' *Wealth of Nations.*

3 Raymond Walsh *The Capital Concept Applied to Man.* QJ Economics 49 [1935].

4 Bertrand Russell *Human Knowledge: Its Scope and Limits.* [1948] at 3. Russell gives more subdivisions to the meaning of *knowledge,* as does *the Cambridge Dictionary of Philosophy*. We believe that it is not necessary to pursue these subsets here.

5 Joel Mokyr *The Lever of Riches: Technology, Creativity and Economic Progress* [1990], and in more detail, developed in *The Gifts of Athena,* [2001].

6 *Knowledge* at p9.

7 Websters, cited by Machlup.

8 Examples are: Open Source Software development, with the establishment of oases of public domain (Creative Commons, GPL) within the borders of a protected right - in this instance copyright. Also the cross-licensing of patents, and patent pooling

9 Rob Koepp *Clusters of Creativity*, the author considers that between the industries of Silicon Valley, knowledge flow between companies is the considered to be norm. See also chapter 7 of *On Competition,* Michael Porter author and ed., [1998]. Also *Competitive Advantage,* Annalee Saxenian, and Also *The Cambridge Phenomenon,* Segal Quince and Partners [1985], and the follow-up report: *The Cambridge Phenomenon Revisited* [2000]. However, this researcher finds that geographical clustering of firms is no guarantee of any form of localised knowledge exchange.

Machlup, following Ryle[10], distinguishes knowing '*that'* from knowing '*how'.* The consensus is that Ryle implied *epistemic* knowledge by 'knowing *that'*, and was talking about taught beliefs - perhaps proven by events, ie facts[11]. Knowing *how*, on the other hand refers to knowledge absorbed from watching a skilled person perform a task then repeatedly performing the task oneself[12]. Thus information on a task algorithm taken together with know-how generates skilled practice of an 'art'.

Habitual practice of an art is likely to be accompanied by a range of advances, from incremental improvements in a technique or tool, to quite different ways of thinking about solving the problem, accompanied by the development of entirely new tools[13].

Joel Mokyr distinguishes two complementary sub-sets of knowledge: Ω- and λ-knowledge. Both sets constitute *useful* knowledge, with Ω-knowledge as *episteme* – or the fundamental scientific foundation of the knowledge base – and λ-knowledge as the *techne* – procedural (or 'recipe') knowledge - the 'how' of it.

According to Mokyr[14] the epistemic base (Ω-knowledge) need not be restricted to the most abstract laws of nature (such as Force = (mass) * (acceleration): $F = ma$), it may also include Cartwrightian *phenomenological* laws[15], Humean regularities, folklore and for example, the classical six 'basic machines'[16].

Mokyr defines λ-knowledge, the technical base – his *prescriptive knowledge*[17] - by contrast to Ω-knowledge, which he defines as the union set of all sets of *know-how, procedures, instructions to make, and recipes* which if *applied,* result in a useful device, compound or method. Knowledge from the technical base qualifies as patentable, since the *utility* of an invention is *a sine qua non* in patent law.

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[10] Gilbert Ryle *The Concept of Mind* [1949] London.

[11] See also variants from Foucault (offering a plurality of epistemes) and Kuhn's notion of paradigm. These are close but not identical, and lead to other ways of reasoning than that pursued here.

[12] Referred to in the computer systems analysis profession as 'sit by Nellie' knowledge. You sat by Nellie, apprentice fashion, until you knew what Nellie knew, (For example: Tom de Marco, *Structured Analysis*).

[13] In modern IPR terms a practitioner achieving a modest step in innovation might perhaps be worthy to acquire a second tier patent (ie one of short duration and awarded for very modest inventiveness).

[14] Joel Mokyr *The Gifts of Athena*, [2001].

[15] Nancy Cartwright suggests that *fundamental* laws are not 'truthful' in the sense of describing the facts on the ground, and an invention is nothing if not practicable on the ground. *Phenomenological* laws, on the other hand, *do* describe the facts truthfully, but they are not fundamental. Nancy Cartwright: *How the Laws of Physics Lie* [1983], and *The Dappled World* [1999].

[16] Wheel and axle, inclined plane, screw, lever, wedge and pulley

[17] Probably also Scheffler's '***procedural knowledge'***, proposed in *Conditions for Knowledge*, [1965], and contrasted with propositional knowledge. The terminology is regarded by Machlup as misleading.

Exploring much earlier concepts of knowledge we find that Socrates seems to have included in the practical skills (*know-how* knowledge), the professional-cum-academic skills of medicine, generalship, and symbolic - ie mathematical – skills, all as the '*technai'*, together with the artisan skills of smithing, carpentry and cooking, and the artistic accomplishments (harp playing). Yet he also refers to many of these activities as *epistemai.* Plato's dialogues similarly give mixed signals as to whether he was prepared to draw a bright line between *episteme* and *techne.* Plato's dialogues show interchangeability in use between the terms for the two classes, but there is emphasis on the specific functions (*ergon*) of the *techne*.

One straw to grasp in understanding these early thinkers' categorisation of knowledge is Socrates' view that <u>*practical*</u> techne *brings into existence products separate from the* techne *itself*, while <u>*theoretical*</u> techne does not, and this view is echoed in the modern concept of a requisite 'technical effect' in an invention under European patent law[18].

The account of dialectic in the *Sophist* reflects just such a distinction between *theoretical* and *practical technai*[19].

The OPAALS *Manifesto* on the OKS advances Stehr's categorisation of knowledge types that are derived in scientific communities. Of those types, the one that interests us here is *productive knowledge*: The authors suggest that most of the traditional disciplines in the natural sciences generate knowledge able to be converted into ways of 'directly appropriating natural phenomena'. To unpack that statement, and reflect on the limitation set on this appropriation, read what the nineteenth century patent lawyer Curtis puts forward as an ontological basis for invention:

> The *direct control of man over matter* consists [therefore], in placing its particles in *new relations*. This is all that is actually done, or *that can be done*, … But *as soon as they are <u>brought into new relations</u>*, it is at once perceived that there are <u>*vast latent forces in nature*</u>, [enabling] <u>*effects and results*</u> of a wholly new character … by calling into activity *some latent law, or force, or property*[20].

[18] Taking the computer art as exemplar, attorneys Sandonato and Rupp interprete 'technical effect' as showing that an invention has (1) *technical background,* for example the constraints of a network solution when implementing a computer program, (2) *a technical objective,* that is improvement of the (computing) machine itself (better speed, power consumption, signal clarity), or (3) <u>*direct*</u> *technical effect:* that is, modifying the behaviour of a physical entity; robotics being the classic example, though computer-controlled chemical or mechanical processes would be classified as 'direct' for 'effecting a physical state change'.

[19] Stanford Encyclopedia of Philosophy.

[20] *A Treatise on the Law of Patents for Useful Inventions* (4^{th} ed), [1873], at xxiii.

A patent system permits invention to emerge from *any or no* epistemic source. There is no requirement for support by citing a Law of Nature or regularity underlying an invention. *Why* the invention works is not required to be known or reported in a patent application[21], only proof of its *utility* – that it works as described (albeit at prototype level). However, reliable utility will almost inevitably reflect some regularity of behaviour, which may be mapped into it at a later time, confirming Mokyr's notion of feedback from technology into science[22].

To provide a balanced view, the elements of invention are considered to be *conception, reduction to practice,* and *diligence,* ie continuous work on the project[23]*.* *Conception* is regarded as the touchstone of inventorship. This signifies the recognition of the ultimate result, and the development of a means to achieve it. Others can reduce the invention to practice.

A.2 Abstract Objects, Law and Protectables

> This part of section A is divided up in the following way: It first attempts to locate a nexus between inventions and Laws of Nature. Genuine *abstracta* are unpatentable since they clearly have no utility; but do IPRs in some classes of invention encroach on a domain which should remain free from legal entitlement? This is suggested most often when either an invention is claimed so broadly that *all* applications of a natural law are consumed by private ownership[24], or in the case of computer programs which were long deemed unpatentable as a *type*[25].

[21] For example, S 103, 35 US Code: 'Patentability shall not be negatived *by the manner in which the invention was made'.* Meaning whether it derives from a theoretical or heuristic base.

[22] He comments: 'the first Industrial Revolution -- and most technological developments preceding it -- had little or no scientific base. It created a chemical industry with no chemistry, an iron industry without metallurgy, power machinery without thermodynamics. Engineering, medical technology, and agriculture until 1850 were pragmatic bodies of applied knowledge in which things were know to work, but rarely was it understood why they worked.' From *The Second Industrial Revolution, 1870-1914.*

[23] (*Jamesbury v Worcester* DC Mass, 318 F. Supp. [1970]).

[24] Morse's description of the *repeater telegraph apparatus* would also cover facsimile machines and television equipment. (Pointed out by Richard Stern at 202, citing *O'Reilly v Morse,* 56 US 15 How, at 62 [1853]).

[25] The US case law that repealed this view did no ontological work in support when it allowed financial software to be patented. (*State Street Bank and Trust Company* v *Signature Financial Group Inc.*, (149 F3rd [1998] at 1368).

> An insightful remark of Nancy Cartwright is that the Laws of Nature are '*only true of what we make.'* In short, if a sufficiently cabined environment for an experiment (or an invention) is created, this effectively warrants its reliable repeatability *under the exact same conditions;* hence it (circularly) obeys the law. She posits the notion of nomological (law-generating) machines. It may be that (some) inventions accused of pre-empting Laws of Nature are none other than Cartwrightian nomological machines.
>
> The section makes a case that if an invention, has sufficient *specificity* coupled to *utility* it is inherently free of any accusation of abstraction, or pre-emption of a law of nature.

The writings of Nancy Cartwright suggest that *fundamental* laws are not truthful in the sense of describing the facts on the ground, and an invention is nothing if not practicable on the ground. *Phenomenological* laws, on the other hand, maintains Cartwright, *do* describe the facts truthfully, but they are not fundamental.

Cartwright talks about a '***vast*** array of phenomenological laws tailored to specific situations'[26], citing as example 'Fick's Law with correction factors'[27]. She comments on the extreme end of this spectrum of situations:

> a law that actually covered any specific case, without much change or correction, would be so specific that it would be unlikely to work anywhere else[28].

Nomological machines, according to Cartwright, must have two properties. Firstly, their basic constitution must be this:

> a fixed (enough) arrangement of components, or factors, with stable (enough) ***capacities***[29], that in the right sort of stable (enough) environment, will, with repeated operation, give rise to ***the kind of regular behaviour that we represent in our scientific laws***[30]**.**

Secondly the machines must incorporate 'shielding'. For example, to demonstrate the law of gravity, using a bank note in a high wind will not *prima facie* verify the law.

[26] *Laws of Physics* at 66.
[27] Such laws encompass what Cartwright refers to as ***basic laws of influence***, those such as Coulomb's law, and the law of gravity. That is, they contribute the effects of having charge, or having mass (ie their ***influence***) to a system.
[28] *Laws of Physics* at 112, also citing Bertrand Russell, who says a similar thing: Russell: *On the Notion of Cause with Application to the Problem of Free Will* [1953 ed.], at 392.
[29] ***Capacity***: the power of a feature to contribute to (to exert *influence* on) the behaviour of a system. For example, electrical charge has 'Coulomb capacity'.
[30] Cartwright *Dappled World* [1999], at 50.

Philosophers Armstrong[31], Dretske[32] and Tooley[33] conceive of a Law of Nature as a relationship between universals[34]. When numerous instances of the law being obeyed continually confirm such a 'law', this enables a statement such as:

> ***For all gases*** at constant pressure, if the temperature rises then the gas expands.

Generally:

S1 $\forall x\ (Fx \supset Gx)$

Yet this universal conditional, says Dretske, has not sufficient force to be a law-maker. It reflects an *observed* uniformity. The number of instances of the law may be almost indefinite, in which case the law can never be confirmed by its instances because we can never collect enough of them.

Why does S1 not represent a law? If we now substitute a co-extensive[35] predicate for F (namely K), we have the set of members we ever had, but we do not have *the law* we started with. This led Dretske to propose that:

S2 Law = Universal truth $\underline{\mathbf{+\ x}}$

The solution for both Dretske and Armstrong[36], is to move up a level, and view a law as a relation between universals - between the ***properties*** of F-*ness* and G-*ness*[37]:

S3 F-ness $\rightarrow$ G-ness[38]

Here Dretske is saying:

S4 If this thing is F … (then ***because*** of the Law) … it is also G

Without that link (bracketed and italicised in S4 above) the law lacks the explanatory power (the counterfactual support) to predict its instances as in:

S5 ***If*** this thing ***were*** F … (*because of the Law*) … it ***would*** also be G

[31] David Armstrong: *What is a Law of Nature* [1983].
[32] Fred Dretske: *Laws of Nature* (Philosophy of Science vol 44 [1977]).
[33] Tooley: *The Nature of Laws,* (in *Laws of Nature*, ed. Tooley [1999]).
[34] Universals are *properties* and *relations*, and are opposed to particulars, which are either ostensive or abstract *entities*.
[35] Coextensive: a totally different predicate, which defines a set with the same membership.
[36] Fortified by similar conclusions from Tooley.
[37] For Armstrong this would be an 'internal relationship', for Dretske it is the x factor.
[38] Following Dretske's convention, the arrow represents some (unspecified) dummy connective, that makes the link that expresses the law.

He says that whereas the universal truth only goes so far as to express a relation between *the extensions* of the terms, to conceive of it as a law is to conceive of it as expressing a relationship between the *properties* which the predicates F and G express.

Armstrong characterises the nomic (law-like) relation: N(F,G) as a second-order universal relation (N) over first-order universals (properties F and G).

These ideas, if valid, offer strong grounds for believing that a Law of Nature is so thoroughly abstract as to be quite unclaimable under patent law.

If nomological machines are to be cast as candidate inventions, clearly their purpose *qua inventions* is not to generate mathematical relations, or 'laws'. But such relations as they do generate contribute to the description of how these machines work, define their variables and may aim at some liaison between the actuality as expressed in a, at best, highly specific phenomenological law, which they obey, and a fundamental (higher order) law, which many things *approximately* obey. Therefore we are saying that there are '*levels'* of law, which the specific phenomenological law being an instance of the generic fundamental law.

Unhappily this argument throws up problems: According to Cartwright, a fundamental law does not wear its approximations on its sleeve. Therefore the notion of the derivation of a phenomenological law from a fundamental one is suspect. She says this:

> The generic/specific account [of the derivation of phenomenological laws] fails because ***the content of the phenomenological laws*** we <u>derive</u> <u>***is not contained in the fundamental laws which explain them***</u>[39].

Neither has she much faith in the generalisation of phenomenological laws in theorising fundamental ones. However, let us continue to maintain that there are levels of laws and they can be related even if not by a direct or easy derivation. Consider the following statement of Rochelle Dreyfuss in this new light:

> Both patent law and copyright distinguish between <u>*principles*</u> and <u>*instantiations*</u> of those principles. *An instantiation can be privately owned*, but *an abstraction must go into the public domain*.

[39] *Laws of Physics* at 107.

If a Cartwrightian machine generates ***utility***, why would it not be a patentable invention, even though it appears to absorb ***all*** applications of the law? If the law is highly specific, then the number of applications is correspondingly low. The meaning of patentable utility and the notion of '*virtual utility'* are discussed below.

Conclusions at this Stage of the Argument

If one accepts Cartwright's ontology one might reasonably assert these things at this point:

1. If there *are* such things as laws, it seems that they can be highly particularised. Perhaps there are enough '*particularised* laws' to go round all the (specific) inventions that are expressed by mathematical relations.
2. If *fundamental* laws lack facticity, surely then they can have no place in embodied inventions, which must work *on the ground*?
3. If we accept that *fundamental* laws are incapable of relevance to inventions, then surely they are safe from monopoly in any event?
4. If there are no such things as laws at all (the fully developed Cartwright view[40].), then *what there are* are purely capacities, 'assembled and reassembled' (Cartwright and Curtis). Therefore, how could a patent claim monopolise anything other than a <u>*specific*</u> *assembly*?

A.3 Inching the Argument Forward: Abstract Objects and Their Part in Patent Law

> Epistemic (Ω) knowledge is not considered patentable in US law; other jurisdictions have either followed suit or have evolved a similar view independently[41]. It is also obvious that a product without a function or some

[40] Cartwright: *Nature's Capacities and their Measurement* [1989].

[41] The EPO still maintains that an invention must have a 'technical effect' in order to quench by that proviso any abstract aspect of an invention. Unfortunately, despite a lengthy series of workshops held by the UK Patent Office, any ***definition*** of what *technical effect* might be eluded the participants. See the report of the UK Patent Office workshops [held Spring 2005], testing a range of definitions of 'technical contribution' trying to determine the meaning. Term arose from case law, attempted definition found in the Directive. About a third of workshop participants were from law, and a further half from software development. Participants discussed the merits of 12 possible definitions, and attempted to apply them across three classes of computer-related inventions prepared by the UK Patent Office. Group A, considered clearly patentable under current law (5 cases), group B clearly unpatentable (5 cases), and group C, (5 cases), which the Office considered borderline. Results (is x patentable/not patentable) varied widely when the different definitions were applied.

> *human benefit*[42] has not the essence of a socially desirable invention that the state would sanction patenting.

The Example of a Computer Program: only a Model of the 'Real World'?

> Computer programs are argued by some commentators to be abstract models of the real world where the laws of nature hold sway. On the logic that patents protect *specific* enactments of these laws for a useful purpose, then a mere model cannot qualify as patentable. Computer programs are *de facto* patentable in the European Patent Office; *de jure,* however, it is illegal to claim a program[43].
>
> The *logic* of allowing computer programs to be patentable is outlined below. In the second part of this chapter we turn to moral arguments for certain domains remaining free of exclusive property rights, and define the Public Domain in relation to IPRs.

The prerequisites for being an abstract object – cannot be located in space or time, not created nor destroyed, not subject to human perception, not causal, make the qualification of algorithms and computer programs as abstract contentious. It might be argued that a program running *as a process* uses signals detectable by sensory mechanisms[44]. The variables used by the program are spatio-temporally located in the computer's memory. They are *addressed*: that is, they are assigned an address at some time. They are thereby created, hence temporal - there was a time when they did not exist. They can be destroyed, in that at some other time an address will no longer reference them. If the machine's power dies, their values are lost. Values in computer variables can be displayed using peripheral devices and thence perceived by us: that is, they are *causal* of perception. Values in variables can be nullified or overwritten. Variables acting as condition flags[45] are *causal* internally to the machine taking some further action. They are set or cleared contingent on the values in other variables. So the computer environment is wired to respond to the appearance of a certain number's representative in a certain variable: values in computer variables can therefore be argued to be causal.

In the US courts there has been a thirty-year history of the availability of patent protection for hardware but rejection of protection of software. We now examine the logic of this position.

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[42] As opposed to an invention that causes human damage – innovations in assassination techniques, for example, and some instances of gambling devices have been condemned as unpatentable!
[43] EPC article 52 (2) (c).
[44] Indeed it is a successful device used in formulating patent claims to use the term 'signals' in lieu of 'data'.
[45] At the lowest level 'flags' are single bits that can be 'set' (valued as 1) or 'cleared' (valued as 0), meaning TRUE or FALSE respectively.

If hardware is legitimised as a (traditional) machine and software is not, then we have a confusion for the technologists, who understand hardware and software as logically equivalent and physically interchangeable. Co-design tools operate algorithms to yield a variety of candidate allocations of the logic blocks in the design between hardware and software. These are filtered on performance criteria alone.

This latter argument also brings us the advantage of drawing attention to another level of abstraction, the logic diagrams from which the *practical* deployment between hardware and software is made. We can now reflect on the possibility that this argument has given us the abstraction we need to argue the concreteness of the (lower level)[46] *deployment* step of casting logic (abstract) to hardware or software (concrete).

There is no answer to the charge that computer programs *only model* the real world, where *tangible* things are governed by laws of nature. Here perhaps we should insist that in the *real* real world, an *original model*, enabled by software to be animated, consume input, transform it and produce output be held legally protectable in virtue of its *utilitarian role as a representative*. Computers are strongly typed machines; they will never deal in anything but data, yet no-one doubts that implementations of algorithms as programs are 'in the technological arts'.

[46] Scott, *Computer Law*, chronicles the frequent occurrence of descriptions of hardwired circuits, which by claim-drafting moves were then passed off using software implementations under the US Doctrine of Equivalents. This states that if any invention comes under the umbrella of the base patent as *an equivalent*, then it is protected by the rights of the base patent owner albeit she did not describe it in the patent, (Ch 3 at s 3.5.2.1). His opinion is that this was tantamount to a fraud on the Patent Office.

No-one doubts the utility of the RSA public key cryptography patent[47]*,* however, twenty-six of its forty patent claims are to a cryptographic *communications system*; (in claim language a *system* is *a machine,* implying hardware, and hence patentability*)*. There are references to 'channels', 'lines' and 'registers', and other general physical elements. The utility of the invention lies in the implementation of Diffie's idea ***as a mathematical solution*** by Rivest *et al*, all this activity prior to coding it as software, or mounting it in hardware logic, and coding is customarily a conventional task[48]. '*Utility'* in the RSA means the problem is solved by *specific mathematics*, rather than to do with the solution being rendered to a computer-readable form.

My argument here is that *some* mathematics is sufficiently limited in application (in use) to be patentable, and that to assess the *specific utility* of such mathematics as expressed in the claim offers a better protection of proper claim breadth and hence the proper *quality* of a patent than claim limitation by physical props.

The diffusion of the focus for software inventions to include ***physical artefacts*** is a solution to satisfy the traditional semantics of intellectual property law. But it only baffles the central question of whether a mathematical claim is excessively broad and ought not to be allowed, or whether it is so specific as to be allowable ***within its utility ambit***.

A.4 The Logical Structure of a Patent

Title 35 US Code Section 101 succinctly states that:

> Whoever invents or discovers any ***new and useful*** **process, machine, manufacture, or composition of matter**[49], or any new and useful ***improvement***

[47] Rivest, Shamir and Adleman: US Pat# 4,405,829 (Class 380/30). Filed [December 1977], issued [September 1983]. Assignee MIT.

[48] 'The conversion of ***a complete thought*** (as expressed in English or mathematics, ie the known input, the desired output, the mathematical expressions needed and the methods of using those expressions) into a language a machine understands is necessarily ***a mere clerical function*** to a skilled programmer'. *In re Sherwood* (613 F 2nd 809, note 6). US Court of Appeals Federal Circuit.

[49] Substantive rights hinge on whether a claim is to an artefact or technique. An *artefact* claim (to a machine or product) is infringed by *unauthorised making, using, selling, offering for sale,* the claimed physical technology (35 US Code s271(a) [1994]). A *technique* (process) is only infringed ***by actually performing the steps in the process***. Therefore in the case of the tangible thing (the artefact), the thief and distributor of the patented technology is directly liable, whereas in the case of a process (such as running a programmed algorithm) the *end-user* only is *directly* liable, and the thief and distributor is harder to reach (being indirectly liable only). IBM's pioneering result in *Beauregard* (53 F 3rd at 1583 [1995]) shows computer programs to be claimable ***on a floppy disk***, (that is, classified as a product). This strategy enables the infringed inventor to reach the true culprit, the distributor of programs on some medium (a disk). By extension, a patent ought to hold for using ***a signal carrier***, across the Internet. Richard Stern reports that the Patent Office inclines toward accepting this kind of claim (*An Attempt to Rationalise Floppy Disk Claims* John Marshall J Comp and Info Law [Fall 1998]).

thereof may obtain a patent therefor, subject to the conditions and requirements of this title.

Inventor (y) is the awardee of monopoly rights in invention (x) only if y proves to be the very inventor of x:

Invented_by (x, y) Pred (1)

Inventedby benignly conflates*:*

Invented (x) and Pred (1.1)

Inventor (y, x) Pred (1.2)

That y invented x may prove to be false on two counts. First, x was invented by someone, but that someone was not y. Second, y merely *found* x and is now demanding property rights in x, though x was not invented by anyone[50].

Section 102 spells out the *novelty* requirement for a patent.

New is not a predicate that picks out a property. It must pick out a relation in which some candidate invention is assessed for recency against another invention of similar sort in order to decide which has the prior claim:

Newer_than (z, x)

Again, going by the term ‘new’, two things are in danger of being conflated[51]:

Earlier_than (x, z) 35 US Code s102 and

Different_from (x, z) 35 US Code s103.

The second relation is made explicit by the requirement under s103, dealt with next.

S103, commonly referred to as the ‘non-obviousness section’ demands the candidate invention show clear difference from the prior art:

Thus the full criteria statement is:

[50] The (so-called) Laws of Nature come under this head. This argument against the sequestration of natural principles has been levelled against software with a relation (an equation, for example) at its core. Some commentators (for example, Irah Donner) have argued that these laws in their more specialised form, ie tailored to meet particular requirements for a specific solution, ought to be patentable. Customarily they would be classified as discoveries.

[51] Because of ambiguity in the language. ‘**New**’: first made, invented … ***different***, changed. (OED).

> y may have a patent for x only if x is man-made and y made x, AND ((x is *sufficiently non-obvious with respect to its nearest neighbour invention* *__at the time of discovery__:* z, peer of x), OR (x appeared above the horizon of the law (by invention or filing*) earlier than* z, where z is similar to x), AND x is 'useful'. x must be a member of at least one of the s101 classes.

A.5 Conclusion to Section A

There are at the moment *de facto* grants of patents for software; overly broad patents are at times issued. The TRIPS Agreement states that all technologies are *equally patentable*[52]*;* but everyone agrees that patents with too broad a sweep are liable to stultify future innovative progress. We have highlighted the confusion of overly broad patents with patents belonging to 'the wrong class of technology'.

This section asks the question: Is it better to 'dress' inventions in physical trappings to achieve patentability for technologies some would classify as abstract[53], or is it better to find a more honest way of claiming, and assess whether patentability will bear testing by ***specific utility***[54] rather that class of technology?

Should we attempt to use logic disruptively on the problem, and question definitional assertions that are made about patentability so as to coerce a debate in the courts, patent offices and amongst inventors and their advisors?

We draw a sharp distinction between the value of a patent for a small, agile and innovative company needing capital investment, and the detrimental uses to which a patent portfolio can be put. This subject is a broad one and embraces the exercise of copyright as well as patents; deeper treatment is deferred for OPAALS Phase 3.

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[52] Unfortunately, TRIPS has become tainted by having roots in the lobby of transnational corporations for their advantage, and in cashing out as a reinforcement of the divide between the less and the more developed worlds. (Susan Sells and Peter Drahos. See also the writings of Susan Strange).

[53] Scott, *Computer Law* [1984], discussing 'fraudulent' hardware claims for a software invention pre-1981; Keith Witek, *Developing a Comprehensive Software Claim Drafting Strategy for US Software Patents*, Berkeley J Tec & L [1996].

[54] Jo Stanley, *Are the Laws of Nature Patentable After All?* Society of Legal Scholars Conference [September 2003].

Part B The Justification for Owning Exclusive Rights in Knowledge

B.1 Free and Owned Knowledge

The *'Open Philosophies'* of the title of this project prompts us to address the subject of what knowledge is currently proprietised, and what is free. This section explores the classic justifications for a Patent System, and the extent of, and justification for, the Public Domain

B.1.1 Machlup and Penrose's Summary of the Justifications for Patents

Attacks on, and defence of patents have over the decades provided a cyclic sport for the economists. Machlup and Penrose reviewed the European controversy over patents that peaked between 1850 and 1875[55]. In 1950 these two authors called for a reassessment of the value of a patent system, complaining of a century of stagnation in thought about its fundamentals. After the controversy, they say, economists seemed to lose interest in the subject until the first half of the twentieth century; Plant, Coase and Arrow, are among the protagonists who next showed interest in the system. Recently the subject has been re-visited by Tirole, Lerner, Kaplow, Calabresi and Melamed, Nelsen, Walsh and Shankerman, and many others.

The two authors summarise four main 'argument types' in favour of patents. The first two focus on reward for the creative individual, the last two are concerned that patent reward to inventors should comport with the public good:

J1 An inventor has a *natural right* to his own ideas; taking is theft

J2 Invention is a *service to society*; the labourer is worthy of his hire.

J3 Inventions and their exploitation are *necessary to secure industrial progress*; patents are the cheapest and best way to keep the inventions coming.

J4 The inventor may take his secret to the grave or keep it closed as a trade secret without *incentive (by patent protection) to disclose*; without disclosure of the current leading edge of the art, progress is slowed down.

[55] Machlup and Penrose *The Patent Controversy in the Nineteenth Century*, J Econ. History, vol 10, No1, [May 1950].

The Lockean argument is that labour is an extension of self, and that self owns its own production (by labour). Labour mixed with a taking from ‘the Commons’ engenders ownership. The Lockean qualifiers are that *enough and as good* remains in the Commons, and that there should be no *waste*. Peter Drahos criticises the Locke’s premises and the jarringly fast path of inference by which Locke travels across weak links of argument[56]. Intellectual property is non-rivalrous, ideas can be used by many people simultaneously, there is no concept that possession by one takes away from others. Therefore transition from a *land* commons to an *ideas* commons is dicey.

The paradox within the set of justifications as pointed out by Richard Epstein and Justin Hughes is this: ‘If the new wealth *remains the private property of the labourer*, it does not increase the common stock’. Machlup and Penrose review prevalent opinion across Europe in the 1830s through –70s that *undisclosed* ideas are naturally under the creator’s control. However, once they are published, this control is forfeit. It appears that during this period of history inventor’s rights smacked unpopularly of (royal/state) prerogative – a *privilege* - and that the term ‘*property,’* perceived as more neutral, was proposed, and adopted with alacrity[57].

[56] Drahos, *A Philosophy of Intellectual Property,* [1996]. Justin Hughes puts forward a view of Richard Epstein that contributed *labour* is merely a smoke screen for the basic idea that first claim of ***possession*** of the hitherto unclaimed is the actual true root of title, Justin Hughes, *The Philosophy of Intellectual Property.* (77 Georgetown LJ [1988] 297). See also the discussion in Joan Schaffner: *Patent Protection Unlocked*, (5 Wisconsin Law Review [1995] 1081).

[57] *Controversy,* at P16. The two authors saw this as an initial political ruse which subsequently crystallised into an *ex poste* justification; the reasoning unravelled, notably in Germany, in the mid to late 19th century.

The second justification had its detractors during the Controversy. They saw the dynamics and cumulative knowledge load in the society as spawning useful ideas, and perceived the inventor to be merely a fortunate first-comer to an inevitable discovery[58]. However in economic terms, competition was assumed to be pretty nearly perfect at that time, therefore inventor's expenses for efforts were seen as reasonable. Whether the Patent System was the best means of delivery of reward was a separate question, the prize system as a contender looked rather worse. A recent commentary from Scott Kieff suggests that needing permissions to use prior inventions in new ones is *not the issue*; the issue is *who possesses* the right to grant these permissions. He uses this as an argument against the prize system, where grant of right to use may accrue to bureaucratic entities that cannot transfer *a legally enforceable right* as the proprietor of a patent can[59].

Justifications 3 and 4 imply commitment to a (social) value-added theory of reward[60]. The *utility* criterion for patentability should secure the social benefit goal, but entry level for utility in US law is so basic – namely that it 'does no social damage'[61], that it carries small notion of 'benefit' as we might want to interprete it. The logic of J3 is this set of assertions:

A1 industrial progress is a good thing

A2 it is achieved via inventions

A3 reward accelerates invention

A4 patents are the cheapest and best way to reward.

[58] Richardo's testimony to the House of Commons Select Committee, reported in The Economist, 26th July 1851 at 812.
[59] The prize system for incentive is dealt with in Ch 3: *The Cambridge Technopole.*
[60] As does legislation against unfair competition, where potential value is lost by crowding out of a better product; the IE battle to secure Netscape's market would illustrate this case.
[61] 'All that the law requires is that the invention should not be frivolous or injurious to the well-being, good policy, or sound morals of society. The word "useful", therefore, is incorporated into the act in contradistinction to mischievous or immoral', Justice Story *Lowell v. Lewis*. (1 Mason 182,15 F Cas 1018 no 8,568, CCD Mass [1817]).

Assertion A3 was not accepted in many quarters[62]. Arnold Plant, more recently suggested that invention was an inevitability driven by '*the instinct of contrivance'*, rewarded or not. This argument weakens the incentive theory which says that work for the public good is so painful that only a property reward will induce its performance. But even if innovative problem-solving is a human instinct, the means to commercialise the invention into a useful, marketable product probably requires resources beyond the inventor's power to provide. As Joel Mokyr points out, there is a variable speed along the *invention/diffusion path*, such that whereas patents may speed *inventive* activity, the monopoly subsequently slows down *diffusion* by a number of factors; among them price rises, scarcity introduction and possible blockings of other innovations[63].

Plant points out that an excellent invention may be incapable of commercial exploitation right now, but a premature patent granted on it may block the development of an entire field. However, early US cases such as *Morse* in their wisdom foresaw the potential population of the scope of a broad patent, and took precautions not to allow excessive breadth of that scope[64].

Drahos and Braithewaite interprete a sequence of legislative moves in America as weakening the rigour of utility as a requirement for patent candidates. This is marked when a change of gear to allow patenting the new biotechnologies occurred, and *identification* of natural or engineered DNA sequences dominated any *utility* they might have which was often speculative[65]. Here the implication is that the social service of *discovery* is more than annulled by sequestration of knowledge out of the Research Open Knowledge Space, into the hands of proprietors[66].

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[62] For example, Rodriguez in De Beaulieu *Discussion sur la propriete des inventions,* Journal des Economistes XXXIV (2nd series) [1862], 82

[63] *Lever of Riches.* [1990], OUP.

[64] *O'Reilly v Morse,* 56 US 15 How. At 62 [1853].

[65] Peter Drahos and John Braithwaite *Intellectual Property, Corporate Strategy, Globalisation: TRIPS in Context*, 20 Wisconsin International Law Journal [2002], 451-480.

At 470. Drahos *et al* criticise the ruling to allow bacteria to be patented in *Diamond v Charkrabarty* (447, US 303, [1980]) (see infra in text), although Donald Chisum views this Supreme Court ruling in favour of patenting living organisms for the of industrial processing they provided as long overdue.

According to Chisum, (*The Patentability of Algorithms,* U Pittsburgh LR. [1986]), many of the Justices of the Supreme Court were rabidly anti-patent throughout the 1930s and – 40s, most notably Justice W. O. Douglas, the author of the *Benson* decision rejecting an algorithm. Two of his more extreme decisions had warranted counter-moves by Congress in the framing of the 1952 Patent Act. Justice Brennan, of similar persuasion, subsequently spoke of 'this Nation's deep-seated antipathy to monopolies' in the later case of *Chakrabarty,* where the new biotechnology was finally allowed to gain a patent toe-hold.

Drahos also comments adversely on the cumulative jurisprudence from the US Appeals Courts in patenting new technologies, albeit Pamela Samuelson commends the carefully developed strand of reasoning from those courts, which was ignored or condemned by the Supreme Court. Donald Chisum

It was A4 of the assertion set that the 19th century economists could not tolerate. Their (social) costs/benefits analysis concluded that the patent system was expensive to run, and engendered a monopoly pricing structure against the consumer. Much earlier Adam Smith had said this:

> People of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices. Wealth of Nations [1776].

As for J4 and disclosure, major software publishers long thrived on a policy of closing code under trade secret, until copyright provided powerful license support, and patents proved a potent strategic weapon in the battle for digital platform supremacy[67]. In the software field, closed code is perhaps the easier option when that code represents what Bruce Perens describes as *differentiating software,* ie that which defines the product or service that constitutes the firm[68]. In the biomedical sector, the inevitable path is via patent acquisition to license, or trade sale or stock market flotation. (See Ch 3).

The worst aspect of this last justification in the eyes of Machlup and Penrose is that the calculated balance of players' interests over the question of whether to disclose or not rests solely with the proprietor, and therefore any issue of social benefit can be shunted entirely.

As an art becomes mature and more crowded, patents naturally become narrower. The patent system for a ballooning art eventually shows the intensity of selection pressure seen in the evolution of the Birds of Paradise. Where these species became densely concentrated within a geographical area, they developed exotically extreme and highly distinguishable plumage; it has been suggested that this 'evolutionary strategy' serves to maintain the species' breeding barrier.

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has called one case in the strand, *Musgrave,* 'the high water mark of rationality'. *The Patentability of Algorithms,* University of Pittsburgh Law Review. [1986] at 970.

[66] Schemes for private subscription DNA databases of Craig Venter.

[67] *Lost Possible Futures: Microsoft's Strategic Behaviour*: Jo Stanley, Anna Rosa Gejlsbjerg, Society for Legal Scholars Conference [2005].

[68] Bruce@perens.com: *The Emerging Economic Paradigm of Open Source.* [visited Feb 2005]. Available at http://perens.com/Articles/Economic.html. Perens is a co-founder of the Open Source movement, specifically of Linux Standard Base. He wrote the Debian Social Contract, a portion of which later became *The Open Source Definition.*

B.1.2 Do the Justifications Justify?

Did we even need a patent system to stimulate either of the UK Industrial Revolutions[69]? Joel Mokyr points to the shaky statistical relationship between patenting and technological activity[70]. Ultimately, as Christine Macleod reports, it became impossible to severe the historical link between existence of a patent system and the industrial revolution of the late eighteenth century onwards, albeit Switzerland and the Netherlands were thriving without one[71].

Peter Drahos *et al* report that in the nineteenth century most patents were owned by individuals. Surprisingly early in the 1900s the picture changed, notably in the United States, but similarly in Germany, and by the 1930s the trend was towards *assigning a patent to the firm* before it was issued. Some ugly developments took place in US patenting during the first part of the 20th century; 'networked' patents gave an opportunity for cartelisation amongst powerful corporations. Inventions were wrapped in a web of patents so thick that no challenge was feasible. This enabled geographical territories to be split amongst agreeing parties and goods to be sold at fixed prices, destroying competition[72]. Inspection of the four justifications for a patent indicates that the greatest value of the system may be just in case there is a homeostatic balance between benefits – for inventor, competitor and public, and that may be just in case the inventor is *small* and working in an ambience of *perfect competition*.

Possibly the British system in early days may have provided a false incentive; by its very imperfection it may have chivvied innovators to greater efforts, since it held out the hope of more protection than, *ex poste,* it proved to give[73]. Recently the justification for its current form has been strongly challenged by Peter Drahos[74]. This inquiry was stimulated by the influence brought to bear by the pharmaceutical corporations of the developed world in the construction of an international IP legal framework of TRIPS that disadvantages the less developed nations.

B.1.3 What is Patentability?

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69 The first Industrial Revolution of the 18th century was superseded by a second, beginning around the 1850s.
70 *The Lever of Riches*, at 251.
71 Christine Macleod, *Inventing the Industrial Revolution: the English Patent System, 1660-1800* Cambridge University Press, [1988].
72 Drahos, *Intellectual Property, Corporate Strategy, Globalisation: TRIPS in Context* [2002] p460. See also Ervin Hexner, *International Cartels* [1946].
73 H I Dutton, *The Patent System and Inventive Activity During the Industrial Revolution* [1984], Manchester UP.
74 *Information Feudalism*, and prior to that, *Trips in Context* [2002].

This discussion is grounded in US law, where the '*balanced sentence'* from the US Constitution on IP protection states its goals:

> ***To promote the Progress of Science and useful Arts***, by securing for ***limited*** Times to Authors and Inventors ***the exclusive Right*** to their respective ***Writings*** and ***Discoveries***[75]

The previous section of this chapter summarised the criteria for patentability in this way:

> y may have a patent for x only if x is man-made and y made x, AND ((x is *sufficiently non-obvious with respect to its nearest neighbour invention* <u>*at the time of discovery*</u>*:* z, peer of x), OR (x appeared above the horizon of the law (by invention or filing*) earlier than* z, where z is similar to x), AND x is 'useful'. x must be a member of at least one of the s101 classes.

We now examine issues arising from the patentability criteria, and make a strong case for developing a true patent predicate, to see whether that could provide leverage against the worst practices in the twenty-first century patent system.

B1.3.1 Inventiveness

US Appeals Court Judge Giles Rich (co-author of the US 1952 Patent Act) advocates that we jettison pursuit of the unfathomable notion of '*inventiveness'* in the patent candidate*,* but instead look for evidence of its *un-obviousness at the time of invention*[76]. Without such a mindset, this criterion is the trickiest of all the assessment criteria. It is reflected in two modern patent dilemmas.

Firstly, if an innovation is merely incremental, ie '*somewhat obvious'*, then it has no business getting a patent. But with 'degree of inventiveness' as guide, a sliding scale replaces a bright-line, and application of the criterion is difficult.

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[75] Article 1 s8, clause 8: Subsequently fortified by the Congressional will to protect ***writings about*** science, and the ***products of*** the useful arts, at the time of enacting the 1952 Act. (S Rep No 82-1979 at 3 [1952] reprinted in 1952 USCCAN 2396)

[76] Giles Rich, *The Vague Concept of Invention as Replaced by s103 of the 1952 Patent Act,* Idea Journal, Conference Number [1964].

Secondly – and this is an issue of European law rather than US law, where the second tier patent system was never adopted - there is a hinterland of innovation between '*incremental*' and *'highly original',* in which petty patent, ie '*Utility Model'* protection may be granted[77]. Mark Janis claims that already the prosecution of a regular patent is extremely costly[78], then goes on to explain why the European model for registered (unexamined) second tier patent protection[79] could be even worse; principally because there is *no presumption of validity* in an unexamined patent.

Janis, from his US perspective, believes that courts would therefore not be inclined to award injunctive relief to second tier patent-holders and that might prove 'devastating to SMEs'[80]. Margaret Llewelyn concluded:

> Neither the Commission, nor any other group, has been able to demonstrate that there is ***a class of definable <u>sub-patentable</u> inventions which warrant intellectual property protection***[81].

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[77] In Europe, full-blown patents are awarded where a substantial *inventive step* is proved. ('Inventive step', European Patent Convention (EPC) Art 52(1) and British Patents Act [1977] s1(1)(b)). Patent candidates need to be appreciably different from solutions already in the art. The European ***Utility Model,*** extensively used in Germany amongst other Union states, applies to lesser innovations. This 'half-size' patent has never been adopted in America. (See Mark Janis, *Second Tier Patent Protection,* 40 Harvard Intl LJ, [1999] 151,at 182 note 173.).
The German utility model was established in 1891. Subsequently the '*Gebrauchsmuster'* system was introduced (date not available), and featured a lowered standard of inventiveness than required for a patent proper. It retained, however, the original target subject matter of the earlier utility model: 'movable articles having 3-dimmensions', (implying tools). Margaret Llewelyn also reports the extension of the original utility model to cover 'most minor inventions', (*Utility Models/Second Tier Protection* [1996], at 5). Mark Janis attributes the 'formal' move to the current utility model, dedicated to 'sub-inventive' innovations (my term) with subject matter overlapping that of patent, as crystallising when efforts at Europe-wide harmonisation began. (Janis, *Second Tier Protection,* at 162). To quote Janis: 'the *Gebrauchsmuster* system is now a fully-fledged second tier patent regime', (at 165). For this reason, Janis argues that the long-standing nature of the classical utility model cannot speak in favour of the currently recommended European model as a tried and tested system, because the new and old models are different, and the new one has, comparatively speaking, a very short history so is not tested to the same extent as the old. (Janis at 155).
[78] Mark Janis *Second Tier*
[79] The Commission Directive for a utility model, COM (1999)309 final, [12 07 1999].
[80] Janis at 83.
[81] Margaret Llewelyn, *Utility Models/ Second Tier Protection*. (Commissioned by the UK Intellectual Property Institute. [Jan 1996]).

B1.3.2 Utility

Utility was for a long time viewed in the United States as the Cinderella criterion[82], until the mantra for patentability in the US Appeals Courts became the delivery of a '*useful, concrete* and *tangible* result'[83]*.* After this, '*utility'* became the load-bearing criterion, though it actually gives us little more than a circular definition of what a patent is about. But the utility criterion brings its own disquiet. In law, premature claims for inventions without defined utility are condemned as seeking a 'hunting license'[84]. The invention must demonstrate some human benefit before it can be granted a patent. Recently a view has been advanced (in the context of biotechnology) that the *utility* requirement operates as a 'timing device' for assessing the 'ripeness' of the invention for control under patent[85].

We revisit this idea in Ch 3, the report on the Cambridge Technopole, where biotechnology and biomedical patents dominate the innovative fields, and patents are regarded as essential for commercialisation.

B1.3.3 The Wrong *Kind* of Thing

Arguably the most contentious issue in the new technologies in recent times has been the US s101 rejections in the courts of the patentability of algorithms. In thirty years of the CCPA[86] and its replacement court the CAFC[87] many appeal decisions (1960s to 1990s) side-stepped those criteria that build the patent predicate: *non-obviousness* and *utility*. Instead the courts hid behind rejections of software for being *an unpatentable type* under 35 US Code s101[88]*.*

[82] Chisum's Treatise on Patent spells out these required elements of utility in an invention: **First** it must be operable and *capable of use to perform the functions and secure the result intended,* **Second** it must operate to *achieve some minimum human purpose*.**Third**, it must achieve *a human purpose* that *is not illegal, immoral or contrary to public policy*. As Justice Story put it, a patent must not achieve utility to 'poison people, or promote debauchery, or facilitate private assassination'. Example case decisions include: a one-armed bandit machine denied a patent (Ex parte Murphy, 200 USPQ, 801 [1977]). A toy racecourse denied a patent [1889], (encouraged betting), and a pinball machine allowed a patent, [1941] (did not necessarily promote gambling).

[83] Judge Giles Rich in *In re Alappat,* (33 F 3rd, [1994]). Reiterated in *State Street* and *Excel* some years later. Currently challenged in newer cases.

[84] 'A patent is not a hunting licence', Fortas J in *Brenner v Manson,* (383, US 519 [1966]). But according to the 'timing principle', a patent could in fact be a hunting licence, if it is considered beneficial to the public ***to attract investment before the full utility of the invention is realised***, and in order to subsidise that development.

[85] Julian Forman: *A Timing Perspective on the Utility Requirement in Biotechnology Patent Requirements,* 12 Albany Law Journal of Science and Technology, 647 [2002].

[86] The Court of Customs and Patent Appeals.

[87] Court of Appeals Federal Circuit.

[88] 35 US Code s101, only allows an invention from the '*four Great Classes'*: 'any ***new and useful*** **process, machine, manufacture, or composition of matter'. C**ases that were remanded back to the Patent Office from the courts frequently had no instructions for subsequent examination for non-

With the State Street decision[89] '4 great classes' of s101 lost their potency to bar a technology type, and there was a rather cowardly retreat into *utility*. *State Street*, the switch-point case, did no ontological work to justify the new course[90].

obviousness. Thus patents issued on reversal by the court of initial PTO rejections, ***without*** further patentability checks.

[89] *State Street Bank and Trust Company* v *Signature Financial Group Inc.*, (149 F3rd [1998] at 1368). Signature's Patent: no 5,193,0536 was filed [1991]; issued [1993].

[90] Judge Rich's decision effectively shrugged off the earlier built opinions from the Supreme Court against the patenting of 'mathematical algorithms' in these words:

> the transformation of data, *representing* discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes ***a practical application*** of a mathematical algorithm, formula or calculation, because it produces '*a useful, concrete and tangible result'*.

B.2 Where Does the Public Domain Come From, What is in it, and Who Says It is So?

Three views are adopted for the purpose of investigation.

View (1) explores '*The Commons'* as what there was before we began to *enclose* it for private ownership[91]. The notion of enclosure has been applied primarily to land and is epitomised by the history of the British Enclosure movement and the opposition to it[92]. It was subsequently applied to establishing exclusive rights in intellectual creations[93], which analogy is flawed, as we shall see.

View (2) sees the (intellectual) *Public Domain* as part scrap yard, and part reject shop for works whose copyright or patent has expired, or that were rejected on the criteria that qualify these rights in the first place. Thus, improved methods of assassination or gambling, blasphemies, Creative Commons-licensed works, the works of William Shakespeare: they are all to be found here.

View (3) adopts a geographical approach, discussing whether protected intellectual property forms a chain of lagoons within a landmass of open access, or currently exists as a continent of protection with infrequent ponds of either vestigial, coerced (compulsorily licensed) or gifted (Open Source) freedoms from permissions. Also, how recursive is the nesting of free and non-free domains?

Under view (1) we mention traditional knowledge and review an example of its appropriation under a US patent as basis for commercial product. View (2) is explored with the curiosity that accompanies any visit to a flea market, turning over the contents in hopes of unearthing a truly unprotectable type – the equivalent of a Rembrandt in the attic.

View (3) perhaps encourages the most progressive exploration, since here there is a chance to capture the balance or imbalance in what the law decrees to be either protected or 'free'. As with continental drift and the sliding of tectonic plates across one another, the picture is constantly changing.

[91] See Garett Hardin, *The Tragedy of the Commons,* Science 162 [1968]. 1243**.** see also Elinor Ostrom *Governing the Commons: Evolution of Institutions of Collective Action* [1990] CUP. See also: *The Comedy of the Commons: Commerce, Custom and Inherently Public Property,* 53 Univ. of Chi. L. Rev. 711 (1986).

[92] From 1801 on, public general enclosure acts were passed in England. The General Enclosure Act of 1845 (8 & 9 Vict. c.118) appointed permanent enclosure Commissioners who were authorised to issue Enclosure Awards without submitting them to Parliament for approval. (The National Archive at: http://www.nationalarchives.gov.uk/catalogue/RdLeaflet.asp?sLeafletID=252&j=1 last visited 11 05 2009.

[93] James Boyle [2008], *The Public Domain,* notably Ch 3 *The Second Enclosure Movement*. See also *Copyright's Public Domain,* Ronan Deazley, and *Altering the Contours of the Public Domain,* Fiona MacMillan, both from *Intellectual Property, the Many Faces of the Public Domain,* ed.s Waelde and MacQueen, Edward Elgar, [2007].

This review lays the foundation for an analysis of ways to introduce an Open Source digital platform into a market economy (rich in patents) of a leading research University, which is the business of chapters 2 and 3, or introduction into the public or social sphere, which Ch 4 explores.

B.2.1 The Commons and Human Capital

In order to invent we need skilled practitioners. The inculcation of knowledge and skills is dependent on a substantial input of *social capital*[94] such that the output is *human* (intellectual) *capital*. In the context of copyright, James Boyle comments that if there is an analogue to common *land* it is the *culture* that spawns new intellectual works, defined as the accumulated knowledge and skills of previous creators[95]. Should the creative person inherit all this richness, yet keep for herself the profits of her skilling as a patent asset? Fritz Machlup develops a rounded definition for human capital, which sweeps very wide, taking in as evidence of 'human investment' these outputs: skills performance, ability to judge, ability to estimate the value of things, and ability to enjoy cultural events[96]. He also cites Milton Friedman's addition that a person can invest *in himself*[97].

Increasingly education is seen as an investment for the individual herself rather than an input from available social capital and public funds[98]. John Schmitt in employment reports for the Center for Economic Policy Research[99] cites the decline in grant aid for education in America from the 1970s onwards. Similarly in the UK, the Universities are expected to rely on internally generated funds rather than state aid[100]. Increasingly the Universities are turning to their innovations for income. Changes in patent policy in Cambridge University are chronicled in Chapter 3 of this report, as is the relative importance of the two incentive methods, prizes and patents. There is a high degree of organized stratification in the way these two incentive strategies chime in across the Cambridge Technopole, and across the maturation of innovative ideas.

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[94] Mostly defined as founded in a network of people having social obligations based on trust as a norm, (Bourdieu, Burt and Putnam); facilitating certain actions of individuals, (Coleman). Perhaps closest to what we mean here is Loury: 'naturally occurring social relationships among persons which promote or assist the acquisition of skills and traits valued in the marketplace'. Loury [1992] p. 100.

[95] At p40 *The Public Domain*

[96] Machlup, Vol 3 of *Knowledge Creation* [1984], Princeton, at 419.

[97] See recent changes in ratio of student contribution to fees, and recent rises in the amount charged to student in fees by the Universities.

[98] For the effects of a dearth of social capital see Coleman, J. (1988) *Social Capital in the Creation of Human Capital*, American Journal of Sociology, 94, Supplement, 95-120. Also Putnam: *Bowling Alone.*

[99] *http://www.cepr.net/index.php/john-schmitt-s-publications/* makes his publications available. Most notably *The Good, The Bad, and the Ugly: Job Quality in the United States over the Three Most Recent*

Jennifer Washburn reminds that any move towards the '*University Inc*'[101], is not without wounds to the academic body. Paul Heald notes that although the US Bayh-Dole Act of 1980 made it much easier for universities to patent their research, the net result (from studies measuring patent citations) seems to have been an intensification of *technology transfer* rather than 'better' research[102].

Heald's assessment of rights in innovation is that patenting and licensing have become the direction for universities to take because such institutions are usually ill-equipped to commercialize their own inventions[103]. Cambridge (as town and University) has actively opposed land development for commercial purposes using various policy tools, including town planning restrictions, as chapter 3 explains. This has led to maintenance of the inventive emphasis for the University, its spin-outs and the web of start-ups within the Technopole. Scaled-up commercial activities, have been forced, in the main, to go elsewhere.

When invited to testify before the California State Legislation on stem cell research in October 2005[104], Washburn expressed as her main concern the need to keep the large body of basic research (generated through public funding) *in the public domain,* and available to scientists. She catalogues many unintended and adverse consequences of Baye-Dole, one of which is that it actually created a perverse financial incentive for universities to seek the most restrictive licenses possible for their innovations, since exclusive licenses are nearly always more profitable for the University.

Business Cycles [Nov 2007], and *Labor Markets and Economic Inequality in the United States Since the End of the 1970s* [April 2005.]

100 Recent HEFCE reports. See also the Lambert's report's focus on third stream income to augment government and research council subsidy and grants. (*Lambert Review of Business-University Collaboration,* [Dec 2003].

101 Jennifer Washburn, *University Inc., The Corporate Corruption of Higher Education*, Basic Books, [2005].

102 See also Rebecca Henderson *et al.*, *Universities as a Source of Commercial Technology: A Detailed Analysis of University Patenting, 1965-1988*, (80, Rev. Econ. & Stat. 119 [1998]).

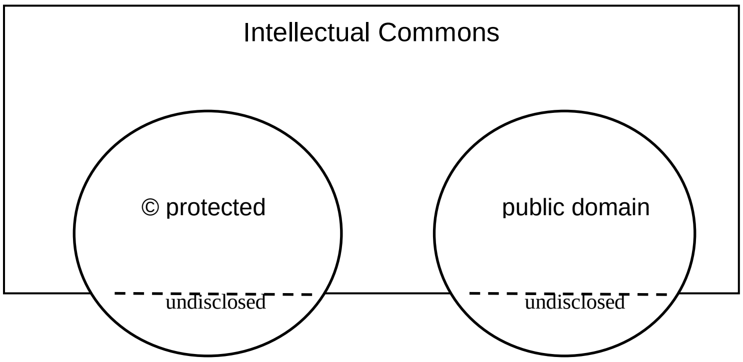
103 Heald's studies of data from national laboratories after Congress authorized the use of Cooperative Research and Development Agreements (CRADAs) tell a similar story.

104 Jennifer Washburn Testimony California State Legislature. [October 31, 2005]. Joint Informational Hearing of the Senate Health Committee. See also *University Inc*.

B.2.2. What are the Contours of the Public Domain; Who Says That it is So?

> David Lange comments that the public domain is 'that which is left over when IP has finished satisfying its appetite'[105]. Lange also comments (in the copyright context) that it is 'a place of sanctuary for individual creative expression … conferring affirmative protection against the forces of private appropriation'.
>
> Discussion of the Public Domain inevitably places copyright before patent. Therefore we begin the discussion there, moving to patents later in the section.

Ronan Deazley draws the spaces he sees as sequestered under copyright and those free of copyright. He hinges the difference between them on need to gain permissions or no need of permissions. He then sub-divides '*meaningful access to'* works from '*use of'* a work.



Deazley's initial casting of free and protected intellectual space

Access might be blocked physically, as it rarely is - Deazley's example is the case of the Dead Sea Scrolls - or blocked by technological protective measures (TPMs) such as encryption or copy controls[106]. But *access* of itself is an end-user's or 'reader's right' *ceteris paribus*; and '*reading'* is not a protected copyright operation[107]; that would be a nonsense. In the United States, early copyright law 'formalities' required deposition of the work at the Library of Congress, *exposure* of the work being part of the IPR bargain. If a bar to *reader's* access becomes tightly coupled to efforts to exclude a *taker,* then the constraint goes beyond its rightful legal powers.

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[105] David Lange *Reimaging the Public Domain*, Law and Contemporary Problems [2003], at p465

[106] See the WCT Copyright Treaty which foundationed the European Informative Society Directive (2001/29/EC). Article 6 deals with TPMs. See also the UK Copyright and Related Rights Regulations [2003].

[107] This notion is further developed by Jo Stanley in a formal model of copyright operations as the method content of an abstract data type called *Representation*. To be developed in Phase 3 of

According to (the dubious logic of) *The Ideas/Expression Dichotomy,* 'ideas' embodied in copyrightable expression are already implicitly in the public domain. Creators' rights over expression, which *are* subject to copyright, may have a special dispensation, since it can be argued that the expression appears *de nouveau* thanks solely to the artist's endeavour, and as a consequence there was no 'Commons' from which to pluck and cordon off a work. One can argue that a useful invention has no such intimate link to its creator.

James Boyle argues that the Commons 'analogue' for the production of copyrightable works is the collection of supporting knowledge that foundations our expressive creativity: the culture, language and prior artistic works on which we draw and without which we cannot create our own expression.

Is the existence of the public domain and IPRs a natural binary relationship? Do they, between them take up all the intellectual space? Fiona Macmillan asks these questions[108]. There is an argument that *no* things in intellectual space, since they are non-rivalrous and incapable of waste, can be owned. The development of intellectual property, with connotations of exclusive possession/use and *ownership,* rejects that idea.

Macmillan maps current perceptions to Roman Law in these terms:

The *res communes* embraces that which was *incapable by its nature* of being owned. The *res publicae* includes those things that an operation of law had made generally available. Thus, an 'agreed' Commons residue lives alongside sequestered intellectual product, though Boyle maintains that encroachment leaves less and less within that Commons. Ideas, scientific discoveries and theories remain at large. Business methods are, by exclusion from patent in the EPC and in the US, until recently, by judicial decision, articles of *res publicae.* Algorithms from the 1990s in America, and databases in Europe[109] are now subjects of IPRs.

In Macmillan's visualisation, the *res publicae* represents more a (regulated) park than the wilderness of *res communes*. It includes objects of intellectual space that we *might have* appropriated for reward, but by some rationalised expediency have let go. So what is the rationalisation?

OPAALS. See also early work in *Scope and Similarity: The Protection of Computer Programs by Copyright, an Ontological Approach*. Intellectual Property Teachers Workshop [2003].

[108] *Public Interest and the Public Domain in an Era of Corporate Dominance*, in IPRS: Innovation, Governance …. Ed: Andersen, [2005] Edward Elgar. Also see *Altering the Contours of the Public Domain*, in *IP, the Many Faces of the Public Domain,* ed.s Waelde, MacQueen, 2007, Edward Elgar.

[109] Directive 96/9/EEC.

Two economists, Joshua Lerner and Jean Tirole posed the question: what keeps the Open Source movement with its non-proprietary operating systems alive[110]. These authors quote from two Open Source leaders. Richard Stallman[111] regards software as necessarily freely exchangeable, with any other option being anti-social[112]. Eric Raymond places his emphasis on the aspirational aspect of the movement, describing the way that developers of Open Source software wish to enhance their reputation under global scrutiny and peer review.

So why *do* developers give a significant part of their time to unpaid work. Lerner and Tirole offer a number of probable incentives: (1) the programmer joins a 'scholarly network', which may be good for her career prospects. Programming contributions are 'flattened' democratically[113], not suffering from hierarchical interference or credit snatching[114]. (2) Peers applaud skilled work, and instead of the anonymity of a company, the programmer enjoys individual recognition; the quality of his performance is visible since it is broadcast. (3) Certain functions to be coded become *hot*, this in turn attracts many participants, and the quality of the work in such an intensively mined field tends to spiral upwards. Therefore the notion of 'no reward' simply because the reward is not an IPR could be illusory.

Macmillan extracts two last clues as to what may not be sequestered from Roman law: the *res divini juris* embraces things too sacred to be owned, maybe a certain flavour of the unownable sacred adheres to patenting 'life', though it is virtually squashed out of existence in the race to acquire rights in DNA sequences.

Finally *res universitatis* delineates a pool of public access within the confines of proprietary rights, such as a scholarly community might establish for an Open Knowledge Space. Unhappily, shared knowledge has been known to turn sour: from co-operative enterprise into configurations of cartelisation.

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[110] *The Simple Economics of Open Source.* [2000]. See also *The Cathedral and the Bazaar,* Eric S Raymond, http://www.tuxedo.org/-esr/writings/cathedral-bazaar. [1999].

[111] (Originally from MIT Artificial Intelligence Lab). Founder, Free Software Foundation, [1983].

[112] See the 'Debian Social Contract' [1995] for the distribution of Linux, which contrasts with the 'General Public Licence' re copyright. The former sets no constraints on code bundled with the Open Source code (it can be proprietary), whereas the GPL (from the Free Software Foundation of Stallman) propagates the terms of that licence (to keep the code open) ***to all added software***, recursively. One example displaying the paradigm is the Debian GNU/Linux Distribution, including 16,000 software packages maintained by a thousand volunteers worldwide.

[113] ***Individual attribution*** is one of the nine key requirements of the '*Open Source Definition.* (Open Source Initiative, [1999]). Apache lists all its contributors on its web site. The founders of Sun, Netscape and Red Hat previously signalled their prowess as Open Source contributors, so there seems some evidence that the skills are bankable.

[114] In case this seems paranoid, a whole economic literature has sprung up in the impact of the behaviour of managers within the firm.

Bruce Perens[115] separates the roles of Open Source and closed code. All firms need *enabling* software platforms: operating systems, email, office applications, etc to run their core business. This he terms ***non-differentiating software***. This is the infrastructure of the firm and its surrounding ecosystem. Such software does not ***define*** the core business nor offer *specific support* to that core, that is the role of ***differentiating software*** that defines the firm and its Unique Selling Point (USP) and supports *only* the firm's unique core business.

Whereas the former ought to be as network-compatible and open standard as possible to enable the flow of information into, through and out of the firm, the latter ought to be closed for commercial security reasons. Both strategies bespeak their own rewards.

B.2.3 An Example Of Sequestration of a Commons Good by Patent

This argument juxtaposes the various protections offered in the Universal Declaration of Human Rights (UDHR).

> *Paragraph 2 of the Declaration's preamble pledges that human beings should have a right to 'freedom from … want'. Article 17 asserts that 'everyone has the right to own property'[116], and Article 27(2) articulates the rights of the creator in his creations: 'right to the protection of the moral and material interests resulting from any scientific … production of which he is the author'. This casts ambiguity on a further part of the same Article, which provides that 'everyone has the right … to **share** in scientific advancement and its benefits'.*

The argument here is as follows: (1) the means of subsistence protection is paramount. (2) The right to possess property and rights in one's own creations is also stressed. Yet (1) and (2) can clash. The example given below firstly provides a comprehensive analysis of the ways that subsistence in less developed communities can be eroded, and secondly locates IPRs in this picture.

[115] Bruce@perens.com: *The Emerging Economic Paradigm of Open Source.* [Feb 2005]. Available at http://perens.com/Articles/Economic.html. Perens is a co-founder of open source, specifically of Linux Standard Base. He wrote the Debian Social Contract, a portion of which later became *The Open Source Definition.*

[116] Art 17: 'right to own …alone as well as in association with others'.

Sophisticated advances in crop improvement are now mainly the product of very large corporations employing thousands of scientists and breeders[117], rather than individuals working alone. By contrast, the crop *growers* in many parts of the world are small scale operators, many single families.

An imbalance of power is apparent when a corporation on the one hand, faces a 2-acre subsistence farmer on the other. It is more sharply apparent with increasing 'globalisation'[118]. In the developed world, on the other hand, heightened corporate power is frequently matched by the parallel expansion of agricultural production units[119].

The following four sources of erosion of subsistence rights from a less developed community are identified. (The use of the terms *type* and *token,* is explained in note [120].

1. Depletion of available product (*tokens*) by outlanders[121].

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[117] *Cambridge Plant Breeding Institute (PBI)* was originally a part of Cambridge University. The Institute was subsequently made independent, and government funded.
With great far-sightedness, the second Director insisted on an holistic approach to the subject of crop development. He introduced new departments such as *Plant Physiology*. A flourishing pure research team worked alongside the applied scientists (the breeders) and the local farmers in the heart of East Anglia's corn land. The whole structure was nourished by exchange with the University, and had its own local testing station, *The National Institute of Agricultural Botany (NIAB).* NIAB was established in [1919] with the initial mission to test and (possibly) to market PBI's new strains.
In 1986, due to the Thatcherite policy of privatisation, the PBI research team moved to the John Innes Institute at Norwich, and the Cambridge site, with the breeders team, was sold to the Anglo-Dutch giant Unilever for £78K, about half of which was the value of the site. This meant that the pure agricultural researchers were cleaved from the breeders and the farming community, and a corporate entity entered the lists on the breeding side, (classified as a 'near-market' enterprise). The station was subsequently sold to Monsanto in [1998] for $525 M. Monsanto has recently divested itself of the enterprise. (*Plant Breeding in 75 Years: 1912 to 1987* published PBI [1987]. See also *Crop and Seed Improvement*, Wellington and Silvey [1997]).

[118] 'To globalise': term first used in [1944]; not common until the 1970s. Associated with enhancement of the mobility of capital, free trade agreements and a decline in government intervention. Susan Strange maintains that the term is void of meaning.

[119] Lord de Ramsey, a large landowner in Cambridgeshire sites the instance of his own 57,000-acre estate. In the late [1930]s, the estate comprised 22 farms, 7 of which were derelict, since the tenants were unable make a living from their land. Today the estate comprises 6 farms. This is a typical East Anglian profile of farm amalgamation. Similar consolidation of land occurred in the United States post-Depression.

[120] **Use of Terms:** the ***type*** of a novel and non-obvious invention is the thing that can be described in a patent's written description and specifically claimed at various levels of abstraction. The ***tokens*** of that type are the myriad concrete embodiments of the type. The American philosopher Peirce distinguished a type from its token. He said this: '*In order that a Type may be used, it has to be embodied in a Token, which shall be a sign of the Type, and thereby of the object the Type signifies'.* These concepts are firmly rooted in linguistics. Here I shall simply use them here as a *shorthand* in the discussion of patentable inventions.
'A type', therefore is an invented or natural kind, and is described *in abstraction*. An inventor has intellectual property rights in both the abstraction and in the disposal of its commodification, the tokens, either via a license or by in-house production.

[121] For example, requisition or plunder; token depletion by forcible taking. An outlander is taken to be someone from outside the community, with whom agents within the community may trade.

2. Sequestration of *types* under intellectual property regimes, either by removal from the community's Commons or by 'theft' of a protected community type, eg a geographical indicator by an outlander[122].
3. Import of food product *perceived to tokenise a harmful type* of crop that may lead to future depletion. (Import of genetically modified grain as food aid, for example, albeit the grain is milled and for consumption and not for sowing).
4. Addition to an ecosystem of tokens of a *type* that may actually or potentially, directly or indirectly, cause damage to the subsistence right. For example, import of inappropriate genetically modified sowing seed.

B.2.3.1 Patenting Turmeric

In 1995, the US Patent Office awarded Cohly and Har of the University of Mississippi a patent for medicinal uses of turmeric[123]. There is substantial evidence that turmeric had been used traditionally to alleviate inflammatory conditions.

In 1998 the *Council of Scientific and Industrial Research of India* challenged the patent on grounds that the invention was not novel, and that non-patent art stating its prior uses had not been cited; the patent was cancelled. Vandana Shiva comments that the EPC, US patent laws, TRIPS and the PCT are failing to emphasise the *quid pro quo* of cross-cultural prior art scrutiny which should be enforced in exchange for the imposition of global IPR frameworks.

B.2.3.2 Is a Seed the Rembrandt in the Attic?

> The theory is advanced in this section that certain innovations defy capture as patented commodities, not by any legal rationale or moral rationale, but by their very innate properties; one such is the seed.

Earlier, we speculated whether a type exists that has been radically innovated, yet in actuality defies being patentable under the current patentability criteria. In this section we examine the nature of modified seeds.

[122] However, Basmati rice could not claim indicator protection, though a massive export earner for India since basmati is not a *place*, which is the assessment criterion for indicators. Similar names are used for a 'me-to' product grown in America. This has cost the Indian economy substantial losses.
[123] US Pat No 5,401,504. *A method of promoting wound healing by turmeric, for oral and topical application.* [1995].

Part of the traditional profile of the patented good is that its tokens – commodifications - *wear out.* The benefit to the rights-holder is to have exclusive control over the production and distribution of wave after wave of shipments of goods, until either the patent period dwindles away, or a more desirable equivalent good usurps his market[124]. In the case of seeds, the wherewithal for '*self-renewal'* inheres in the good itself. It can *duplicate itself* and worse, from the rights-holder's standpoint, multiply itself[125]. Therefore, on its face, 'term of patent' becomes meaningless, since the buyer of the seed potentially has the token in perpetuity, and can theoretically shunt the rights holder, and even sell on the commodity in bulk[126].

B.2.3.3 The 'Make, Use and Sell' Rights in US Patent Law[127] and the Seed

When the farmer grows protected crop plants from seed, willy nilly he makes more of the same product that he bought (the wheat ear contains the progeny of the purchased commodity).

There is a dichotomy in the use of a crop plant. Firstly, it is used for food, clothing, fuel or other direct consumer purposes. Secondly, it can be used recursively[128] by the grower, as the seed progenitor.

If the seed is used as progenitor, will the progeny be the same product as was assessed by examination in the written description? Sexual reproduction is in the business of generating profuse *variation* for natural selection to pick amongst. Hence second-generation seed, which the grower has 'made' may (theoretically), under the 'all elements' test for infringement[129] fail to infringe the original developer's product.

Even the seed under the developer's own control may drift away from the described, patented object in its future generations, such that the deposited sample, and the written description no longer match the commodity at some future date.

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[124] It is one of the natural controls on a patented good, and a hazard to the patentee that early in its life the patented good faces older, poorer, but probably cheaper technologies, and late in its life it faces newer, more efficient competitive technology. See Edmund Kitch *Patents: Monopolies or Property Rights?* (8 Research L and Econ. 31, at 31. [1986]).

[125] If it breeds by sexual means, it can also modify itself in successive generations, which (theoretically) could endanger the validity of the patent's written description.

[126] The analogy in software is to make a back-up copy. This is permitted under copyright law, (17 US Code s117), but if the software is *patented*, a backup violates the 'make and use' rights. There is no notion of 'fair use' in patent as there is in copyright, and there is no extenuating clause equivalent to 17 US Code s117 in patent law. But see the protection of seeds under the [1970] US Plant Variety Protection Act where the farmer may save limited amounts seed to replant *to the capacity of his land*. However, as the act was amended, he may no longer sell his 'farm's worth' of seed on.

[127] 35 US Code s154. For infringement see s271(b).

[128] Year after year after year.

[129] *Graver Tank v Linde Air:* 'function, way, result' test (339 US 605, [1950].) Refined to the '*all elements test'* in *Pennwalt v Durand-Wayland* (833 F2nd 931 [1987]). But this test was relaxed in, for example: *Corning Glass v Sumitotmo* (868 F2nd 1251 [1989]).

The written description problem was bad enough to cause such difficulties with the standard US utility (s101) patent that the Plant Patent Act[130], with its weakened written description requirement, was introduced in 1930. It addresses ***only asexually reproducing types,*** which are (duplicate) clones. Absence of sexual variation renders the written description more reliable.

The argument for the impossibility of patenting the seed does not stem from any high-flown notions of 'not patenting life'. The lower court reasoning in *Chakrabarty* was so much more interesting than the famous Supreme Court opinion. Judge Rich, arguing in the CAFC[131], held that the bacteria which helpfully consume oil spillages are patentable in virtue of their '*industrial processing'* activities. Is it the case that although arguments may be brought to bolster the patentability of some biology, when it comes to the seed, its functional logic defies patentability. Is it truly a Rembrandt in the attic?

Conclusion to Parts A and B

In this chapter I have put forward logical, economic, legal and philosophical reasons for having single source protection of creations of the mind by patent.

I have taken to extremes the notion that even 'instances of Laws of Nature', if sufficiently *specific* and displaying enough *utility* in their (few, limited) occurrences could logically be considered as candidates for patent.

I hope that this chapter has pointed towards arbitration of the control of patentability as needing to weigh social and moral values alongside economic, logical and legal ones. This chapter deals with only half the story of exclusive protection by intellectual property rights. The other half is copyrightability, licensing and the role of the public domain seen as so critical to the communications industry and computer-implemented technologies. This second half of the debate will be visited in OPAALS Phase 3, with analyses of the work of Susan Sells, Susan Strange and Peter Drahos in the field of global impact of IPRs.

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[130] PPA [1930]. Now Title 35 US Code sections 161 to 164. Section 161 describes the subject matter as the product of asexual reproduction. S162 specifically allows the relaxation of 35 US Code s112 'if the [written] description is as complete as reasonably possible'. Section 163 is a modified version of the utility patent's 'make, use and sell' exclusive rights; this section was amended in [1998] to include 'parts of plants' to solve an ambiguity.

[131] Discussion by Judge Rich in *Application of Bergy* and *Application of Chakrabarty* [1977] (563 F.2d 1031), and [1979] (In re Bergy, 596 F.2d 952 CCPA 1979), on remand from *certiorari* in the Supreme Court after the vacating the previous CCPA decisions in these cases where the Judge maintained that biological conversions mediated by microorganisms are fundamentally an application of basic chemistry. (596 F 2nd 952, at 981).

Most importantly this will be linked to the policy decisions on IPRs taken in the Cambridge Technopole, where inventions tend to have immediate access to global markets.

Chapter 2

The Role of the Regional Catalyst in the East of England

Keywords: commercial intelligence; segmentation of the market; friends of the project; demonstrator; feedback; holistic approach; iterative education; tacit networks.

2.0 The Meaning of a *Catalyst*

The OPAALS project, and the DBE project before it, have used the term ***Regional Catalyst*** for an individual or collectivity studying a particular region to determine the feasibility and acceptability of introducing a European model DE to support regional companies.

A catalyst speeds up the rate of a (chemical) reaction. It takes the reaction to its native equilibrium point *faster;* it does not alter the inherent nature of that reaction nor its equilibrium point. This implies that the catalyst can only achieve *what the nature of its reaction environment will bear*. The catalyst does, however, reduce the need for the application of drastic amounts of other conditions, (such as temperature and pressure in the chemical case[132]). Where the project itself supplies one reactant (DBE) and the region supplies the other (SMEs with an unmet need for a community computer platform), the Regional Catalyst raises awareness of the possibilities of adoption (the reaction).

A catalyst is not itself altered by the reaction. Yet in the case of a '*Regional Catalyst'* this seems to indicate a missed opportunity to *have one's mind set changed by the findings,* and report this back to the Project. The most important impact of the work of the Regional Catalyst may be to elicit an **autocatalytic** response in terms of driver adopting SMEs (the reaction product). Here the classic definition of the process is that one of the products of a reaction (a converted SME in this instance) may accelerate the conversion of other companies to the use of the DE platform[133].

In the present investigation it is considered valuable to derive experience from the region and apply this to the project, not only to inform a specification for software requirements, but also to inform the 'marketing approach' of regional dissemination.

[132] OED and Dictionary of Chemistry. Its use in business contexts is less strict.
[133] Note that the noun ***catalysis*** is best avoided, as the dictionary meaning is given as 'dissolution, destruction, and ruin'; OED.

Overview of Activities of the Role

- To gather enterprise intelligence about the regions via the regions' agencies, firms, facilitators and professionals, reporting the established regional enterprise base, aspirations and social capital.
- To translate these into requirement specifications for (a) DE dissemination and, (b) with assistance of the computer science partners, a design for DE regional deployment.
- To identify those regional collectivities (agencies and networks) or individuals that might view DE adoption favourably, and locate opportunities for penetration by the European model DE. To make 'friends for the project'.
- To identify unique features of the current DE design particularly suited to fulfilling regional needs. Examples are: (1) the protection of firm autonomy, data, business model and IP[134]. (2) The reduction of costs where government money is spent on repeat proprietary licensing of municipal software[135]. (3) The 'green' aspects of a fully distributed system could be favourably received in Peterborough where the regional emphasis is on Clean and Energy-conserving technologies, and the entire ERDF budget is being spent within this framework. (4) Facilitating networking by ***free*** provision, notably where the non-digital business networks are prohibitively expensive, or hard to access in person for SME proprietors, due to time and other resource constraints[136].
- To prepare/collect material from OPAALS partners that is ***at the right level*** for dissemination to the entities identified. ***(Very time-consuming).*** The necessity for a software demonstrator is pointed out by friends of the project who are also investors. 'Show the product' is advice customarily given to companies trying to attract new customers; the OPAALS DE adoption environment is a similar 'market' situation.
- *Iterative education* to make potential adopters aware of the upcoming technologies being incorporated in the DEs, and benefits as compared to their present systems.
- To ***monitor change*** in the regional industrial/commercial configurations and requirements in light of the current economic downturn.

2.1. A Challenge for a Regional Catalyst: Dissemination Material

[134] Surrey's loosely coupled SOA architecture is conducive to this goal.
[135] Examples are: Town Hall administrative computer provision, school and public library systems. The goal here could be satisfied by an Open Source open license software platform.
[136] Although The Huntingdonshire Business Network costs only £50.00 pa membership fee, with instructional seminars costing £5.00 to £10.00 each, the Peterborough Business Network costs £600.00 pa, and the Peterborough Women's Networking Group is £200 - £300.00 pa, with business lunches at £20.00; only the taster coffee mornings are free.

2.1.1 The Scope of the Project and Conceptual Grasp by Potential Adopters

It is hard for the firms[137] and hubs[138] to conceptualise a Digital Ecosystem[139] without explanation by the Catalyst *at a very early stage in negotiations* of its *tangible business benefits*.

Co-operative structures are beginning to develop amongst the smaller environmental firms in the SB sector in Peterborough. This is mostly as a response of resident firms that they need to throw in their (innovative) lot together since government assistance schemes, when inspected in detail, do not map to their requirements[140]. Some of these firms *do* grasp the significance of a DE and OKS, most notably those with more overseas experience, for example, a construction firm dealing with eco-builds in Brazil and the Philippines, where interest in their low carbon products seems to far exceed that shown in the eastern region of the UK.

2.1.2 Who Must Be Approached?

> Candidates for negotiations are found to be *individual firms, hubs*, both public bodies and *private agencies*. Also vibrant networks open to fresh ideas[141].

1. Advice from the Cambridge Institute for Manufacturing (IfM)[142] is unequivocal: the small high tech firms of Cambridge are unlikely to give time to researchers unless a researcher is offering something useful to them specifically. (The IfM offers cheap student labour, which the firms are glad to accommodate). Therefore approaches to individual firms in the Cambridge Technopole are not prioritised. Notwithstanding this time scarcity aspect, some Peterborough small firms were happy to assist, and attempt an integration of DE principles into their own core business plans. However, the prospect of reasonably middle-term deployment-ready software was necessary for this integration to proceed any further.

[137] Almost entirely dealing with the VSB/SB size sector. In Cambridge Biomedical firms dominate, with substantial numbers from software, wireless/communications, and chip sectors. In Peterborough dominated by eco-industries, notably water and waste treatment. Most are large companies with minimal aspirations to innovation. A few small and innovative businesses have been attracted by the brand name of the UK Eco-Centre, recently set up there.
[138] Local government, RDAs and fostering agencies such as Business Link, the Chamber of Commerce and the local business networks
[139] The Wikipedia definition is given as: 'A Digital Ecosystem is any distributed, adaptive, open socio-technical system, with properties of self-organisation, scalability and sustainability, inspired by natural ecosystems. There is growing acceptance of the term as defined, [more broadly than just business] most notably by the World Economic Forum'. http://decommunity.net/.
[140] 3 SME interviews from the eco-build industry. Interviews 52, 56 and 57.
[141] Interviews with the Cambridge University Technology and Enterprise Club are arranged for early July 2009.
[142] Telephone interview 61, representative of the Cambridge Institute for Manufacturing.

2. Hubs such as the Innovation Centre in Peterborough and Local Government structures are obvious key players capable of (1) disseminating knowledge about a DE/OKS and (2) utilising available funding to set up DE platforms that offer value to the SMEs. However, the hubs present the following challenges to DE recruitment:

   - There is either (1) no Chief Information Officer with sufficient awareness of platform options (Open Source as compared to proprietary, advantages and drawbacks of each) or (2) all proposals for policy change on the scale of migration from proprietary to community computer platforms must feed through CEO level *before* technical people are called on to inspect proposals[143]. Since many of the benefits of a DE are best expressed at technological level, dissemination is consequently hampered.
   - The (CEO) level of those hubs studied is, firstly, hard to engage; technical problems of the kind addressed by the DE are of lower priority than - and not considered related to - pressing local socio-economic problems, and staying within budget. Secondly, the local government culling mechanisms that sift candidates for supplying goods and services are so comprehensive and have such an extensive spectrum of legislative and regulatory requirements that (a) small firms in any sector and (b) computer supplier firms of all but the largest size, are eliminated by 'check box factors'[144] geared to prioritise contractual security for the purchaser, who, after all, is spending public funds[145.] Add to this the increasingly frequent cultural changes that occur within the hub structures themselves, and the 'anti-networking' moves of shifting staff around, requiring the establishment of new relationships on the part of the researcher, with no history or good-will build-up possible. This was especially marked at Peterborough.

The prime candidate for in digital ecosystem collaboration in Cambridge is the Centre for Entrepreneurial Learning (CfEL) at the Judge Business School, under the

[143] Interview with a City Council representative, first city. Interview 40.
[144] Environmental regulations compliance, maintenance contract guarantees, guarantees that the company will be in existence for the duration of the contract, bias towards suppliers known to the procurer network already, eg prescribed on the government approved list.
[145] Interview with a County Council representative, second city. It seems to be active policy in some local government to *reduce* the number of firms dealt with contractually to reduce costs; this places the SBs at a disadvantage. Interview 51.

direction of Shai Vyakarnam. This from John Snyder[146] describes the approach of CfEL:

> ‘Entrepreneurial individuals and companies are not just seeking *an ecosystem of money and business transactions*; they have a thirst for knowledge and they want ***many different people*** or knowledge ***cash-points*** from which they can draw to find what they need. Cambridge provides this[147]’.

This conceptualisation might point to the value of a network model with heterogeneous nodes: departmental hubs (generic subject areas) and spokes to nodes for individuals with specific expertise within a given generic compass.

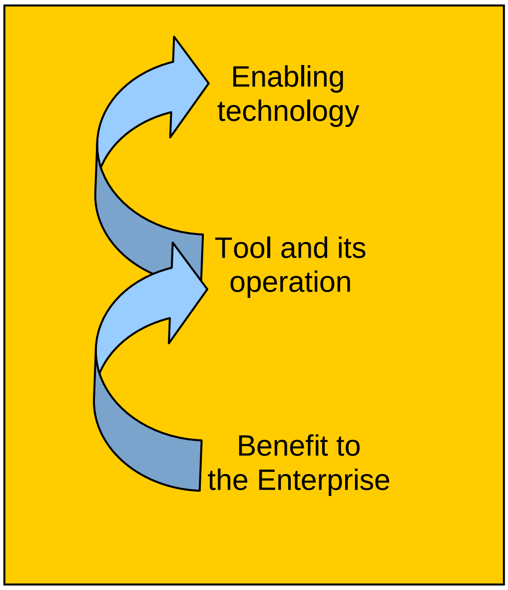
CfEL is currently questing for partners in progressive projects, including digital platforms. This report recommends that approaches be made to the Centre to assess mutual goals. An example of a current collaboration is ‘*Comparative Analysis between Cambridge and Arezzo Entrepreneurial Clusters*’[148]. An example of the type of collaboration sought by the Centre is ‘*Comparing Cambridge with Other Areas, using the same Methodology of Social Network Analysis*’[149].

2.1.3 The Necessity of Making the Benefits of DE Adoption Explicit Early

2.1.3.1 Road-blocks

Firstly, prevailing proprietary computer platforms are not necessarily perceived as having short-comings except where interoperability failures chill out core business or administrative activity and lead to resource depletion. Secondly, the implications of a *fully distributed* system, with its particular requirement for a secure identity model, its preservation of firm autonomy and the communication scope offered by an OKS, are not necessarily appreciated or even understood where technical knowledge is absent.

[146] Entrepreneur in Residence at the Judge, author of the *Cambridge Advantage* presentation.
[147] John Snyder, Entrepreneur in residence at the Judge Institute.
[148] With The University of Sienna and Florence.
[149] CfEL web site last visited June 2009.



It is suggested that the problem is attacked bottom up, (1) using a description of prospective *benefits* (over and above what current systems can provide), (2) succeeded by a description of (recognisable) desktop *tools* than can be mapped to what is already within the experience of the audience. (3) Lastly, tools are mapped to the *concepts* of the enabling technologies behind the desktop.

Although these ideas may be presented simultaneously, their acceptance is anticipated to be gradual and sequential.

2.2. Prior Work in the Regions by the European DBE Project

2.2.1 Concept Introduction and the Response of the Policy Makers

The results recorded from the Aragon Study[150] state that the DBE initiative resulted in the Government of Aragon launching a call for tender for the creation of new services based on the DBE Technology [2006]. The aspiration was to find a critical mass of SMEs to participate[151].

The need which a DE offers to satisfy is for easy and adaptive access paths for entities trying to locate skills and services. The process seems to be shunted in certain Cambridge instances. This example was recorded from a small Cambridge data logging company. The path of inquiry to locating their skills was not via any specific network or directory but chaotic[152]:

> An Edinburgh firm, seeking a system to complement their CO_2 measurement methods, located a small Cambridge firm by a very complex route of informal links. The company needed, it would appear, a ‘flexible intelligent approach’ to their system, and had heard of ‘The Cambridge Phenomenon’. It first located the Cambridge cluster websites and explored these, then using those and other sources and links searched until it finally located firm 54.

[150] At 169 DBE Book.

[151] No formal analysis seems to be available of the longer term results of DBE introduction, but informal sources report a dwindling of companies’ support across time.

[152] Interview 54.

It appears that the Cambridge 'brand' came first, followed by a search of sector and specific skills within brand. Informal discussions indicate similar serendipitous paths are frequently taken in making such contacts.

The DBE Irish study admitted that 'the DBE is a very complex concept to explain, and is ***addressed to several audiences*** at the same time'[153]. The study suggests that material for dissemination would be the OPAALS films (which the study graded for the various audiences) and the one-page, high-level view of the project[154].

In the East of England study, these materials were less than successful. The **short** REDEN statement of goals was probably the most efficacious document available for an introductory approach[155]. Now that the project is proceeding into an implementation stage, these conceptual materials are considered insufficient for present purposes. The great majority of participants in the study wanted to know when a usable system would be available and how they could road test it; they were far less interested in the conceptual qualities of the DE project.

One of the main reasons for lack of penetration by materials was that most of the proprietors of firms, leaders of Science and Business Parks, and advisors to Local Government are not primarily technologists themselves. In addition, they have immediate practical problems to solve and when offered an alternative digital platform, look first for *specific benefits to their own enterprises*. They have difficulty in contexting these within the very large scope of the OPAALS/DBE project without tangible (preferably short term) benefits being spelt out for them.

> It is important to realise that ***technological ignorance should not be under-estimated*** simply because the participants in the inquiry are brilliant practitioners of their own professions[156].

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[153] Bertrand Dory, *Policymakers: Making the Region a Good Place to live, to work and to invest*, DBE book at 163.

[154] At p164.

[155] As a consequence a synopsis of *Regions for Digital Ecosystems Network REDEN, Mission Paper* by Lorena Riviera-Leon *et al* **as slides** was disseminated, but considered by one Cambridge Bioinformaticist too abstract to connect with the database work he carries out. This participant has very high ICT skills, and wished for more technical detail *specifically* related to his applications than could be derived from synopsing the Surrey and Waterford work. Interview 55.

[156] For example, the paragraph: 'the OPAALS approach to a Digital Ecosystem emphasises the **fully distributed** basis of the technology used**.** The service layer is Service Oriented Architecture (SOA) based, and the model lays the utmost emphasis on strict adherence to the original SOA principles of loose coupling between users and providers of services and the service platform itself', was essayed in one introduction sent by out by the Cambridge Regional Catalyst to the computer officer of one hub. It is now considered incomprehensible to many targets, who have no notion of any of the concepts expressed, and insufficient technological background to be able to explore them, *though their professional label may indicate charge of computer services*. As with the West Midlands study, issues of *absorptive capacity* were encountered.

2.2.2 Advice on Dissemination from a VC Consultant to a City Council[157]

The key points made by this successful venture capitalist, now a consultant to Local Government in 'first city' in the East of England, are listed below[158]. Her preliminary advice to OPAALS was this:

- *There should be a communications machine.* This is now being addressed by the OPAALS ICT layer.
- *There should be business milestones – completion dates.* These are not yet finalised within the OPAALS project, since the software layers of the OPAALS DE are developing at different rates.
- *There must be the concept of a 'product'.* As above.
- *How do we propose that the scheme should be introduced?* No rollout details have as yet been identified as produced by the project.
- *Evidence of project management for roll-out is necessary.* As above.

The VC (a non-technologist) recommended a very practical approach to dissemination, with answers given to the following points in very specific terms:

- Who are we (OPAALS/DBE[159])? Why (exactly) is the EC funding us? What (concisely) is our message? What are the advantages of our scheme? What are our prior connections? What is our track record? Is anyone else doing the same type of thing? What is the *specific* benefit for the city approached? Where has the scheme been applied successfully before, (testimonials)? How will the implementation be effected? What are the likely time scales? What would be the true, full cost of the switch from current to new provision?

The VC also suggested that the following points were liable to count against us:

- A *non-commercial stance*
- Anything which, under some interpretation, could be construed to lend a '*left-wing'* complexion to the project

[157] A one-time venture capitalist in a company based in southern Europe.
[158] Interview 40.
[159] The full title of the OPAALS project was not explained, as the audience are unfamiliar with the adjectives used. The 'open' philosophy was described in all its aspects, after which the currency title used in discussions was Digital Ecosystem.

- Any *social* emphasis in the project, since computer technologies are perceived by most audiences (firms and hubs) to address a *purely business advantage*[160].
- A '*not for profit' ethos*, which would raise suspicions, since no one believes anything is actually free.

Encouragement from the VC came in the form of the anticipated impact of the OPAALS philosophy:

- There would be great excitement engendered by the *concept* of a DE as described in broad brushstroke terms.
- There would be enthusiasm and support for a concept of such *huge scope* being born, developed, and succeeding.
- OPAALS could expect '*friends of the project'*, including herself[161] to promote its ideas, *once initial clarity as regards benefits was achieved*. The VC offered consultant-level advice on OPAALS presentations for a range of audiences *gratis*[162].

One eminent leader of a Business Park in Cambridge suggested dissemination tools should be brief, simple and succinct, and recommended the 'selling sheet' model[163]. Less pithy and more abstract diagramming and explanation of the project was not successful for dissemination purposes. The Regional Catalyst prepared a sample Selling Sheet, (still under test), based on the *journalist's grid concept:* ie "*'who?' 'what?', 'when?' 'where?' 'why?', and 'how?' – the project".* (See Appendix A).

2.2.3 The West Midlands DBE Work and OPAALS Work in the East of England

Considerable work on dissemination was carried out by a large team at the University of Central England between 2003 and 2007[164]. Again, assembling a critical mass of SMEs was described as 'demanding'. Part of the explanation for this would likely be issues of ***Network Effects***[165]. Where 'markets' for a networked good, such as a

[160] For socio-economic work, see the Peterborough report, Chapter 4.
[161] Another ***Friend of the Project***, also a consultant, operates as a Senior Advisor within the East of England Business Link organisation, and has offered substantial support and a set of contacts within the region in the socio-economic domain. Interview 59.
[162] The above points from the VC were prepared as slides for a General Meeting of OPAALS at the LSE in winter 2008-9.
[163] Interview 58.
[164] *The West Midlands Regional Catalyst Role in the Activation of the Digital Ecosystem*, Konda, Bayon and Shelton. DBE Book at 170.
[165] Otherwise known as '*demand-side economies of scale'*. The concept of network effects or network externalities, means that a good's value is not intermediated by the market. The value to a network

computer operating system, file format or any kind of digital platform exist, an *installed base of users* belonging to the first-comer supplier to the market has *extra value* for subsequent joiners, since it enhances their ability to communicate with others having the same facility. Where the installed player has dominance of the market (eg group server operating systems) or super-dominance (eg home user operating systems), the market entrant in a network market has a difficult job to penetrate.

The West Midlands authors point out that 'creating critical mass was slow *as there was nothing to show [prospective adopters] except a set of concepts'*[166]. A hierarchical structure of *Catalysts* was established with a cluster of SMEs to each Catalyst. Within SME clusters, candidate *Driver SMEs* were offered financial incentives (50% of costs up to a max of 12,000 euro), though for some potential adopters this proved insufficient. Contact with adopters took the form of one-to-one meetings (repeated in the East of England). Also seminars and workshops were used (not repeated in the East of England).

As in the West Midlands, the present study published articles and reports to disseminate project information. These included: a report placed on the Cambridge Chamber of Commerce web site, an Open Letter from a local postal logistics firm to the *Huntingdonshire Great Digital Debate*[167] entitled *A Digital Business Ecosystem for Huntingdonshire.* Dr Chris Thomas of Milton Contact published favourable evaluations of the DE concept on his company web site and that of the Huntingdonshire Business Network, following a meeting with the Regional Catalyst and a representative from a major local government hub.

The West Midlands team proposed actions to be implemented in Phase 2 of the DBE project, including '*development of DBE specific learning material based on internal documentation and the extraction from public domain documents'.* They show intention to segment the market and direct specific presentations to business adopters, using a range of channels, and creating regional case studies. A representative of the Centre for Entrepeneurial Learning (CfEL) at the Cambridge

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joiner of an extra unit is *higher* the more units that are already sold, everything else being equal. The DBE is a network 'good'. See Nicholas Economides, *The Microsoft Antitrust Case* [2001] s2.
The worst-case scenario for a second-comer network entrant to the market would be if the network market finally tips so that it is disproportionately difficult to recover a competitive position. See *Dominance and Duty in the European Union: a Look Through Microsoft Windows at the Essential Facilities Doctrine*, Mercer Harz, 11 Emory Int'l LR, 189 [Spring 1997], at 213; and see footnotes 124, also 153 *et seq*, *re* the *Memorandum of Amici,* regarding theoretical support from Kenneth Arrow.

[166] DBE book at 170.

[167] Auspices of the Huntingdonshire District Council and EEDA [2008].

Judge Business School has pointed out that the OPAALS project needs ‘a range of pitches’ to address a range of audiences. She had noticed that business language varies subtly even between gatherings of entrepreneurs in London and Cambridge[168].

In 2007 the West Midlands team reported ‘a delay in the availability of the DBE architecture’, such that a change in engagement process was embarked on[169]. The report comments that the work:

> [failed] to yield the required results [across three pilot regions] in terms of the number or variety of developers joining the project.

This despite a range of approaches[170]. The UCE team became increasingly aware of ‘the need *to fit DBE with regional strategy and policy in order to relate well to the development agencies’.*

The East of England Catalyst’s response to this pointer[171] was to liase with a manager within the Peterborough Regional Economic Partnership (PREP)[172] to devise a bid under the *ERDF Competitiveness Programme 2007-13.* The proposal was for a *Peterborough Digital Business EcoSystem[173].*

The liaison with the PREP partner was initiated by a joint meeting with the Surrey OPAALS partner, the Cambridge partner and a representative SME from the Cambridge biotechnology cluster[174]. (See Appendix B). Briefly the overall purpose of the bid is expressed in early draft proposals as having the following goals:

- to enable businesses and organizations to co-operate and share knowledge ***without risk of surrendering business-critical data***, which current environments incur.
- To provide a service platform that would be a *fully* distributed. This property to ensure ***no single point of failure*** and, importantly, ***no single point of control***.

Surrey and Cambridge, later joined by the LSE[175], bent their efforts to candidate DE/Cloud Computing schemes minimising energy usage, so as to be in kilter with the low carbon ERDF criteria demands of the Peterborough bid[176].

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[168] Interview 59.
[169] DBE Book at 174.
[170] Tampere: SME driver oriented; Aragon: sector specific; West Midlands: intermediary focused.
[171] See Dory p163 DBE Book, advice to locate an efficient entry point with a local policy-maker.
[172] Now merged into the part private *Opportunity Peterborough* initiative, operating out of Peterborough City Hall.
[173] The socio-economic aspects of a DE had to be explicitly ignored under the terms of the grants, since *business benefits* to local SMEs and *job creation* were the focus of the initiative.
[174] Minutes of the Meeting at Appendix B.
[175] Discussions between Gerard Briscoe, Alexandros Marinos and Jo Stanley, Spring 2009 during development of a paper: *Digital Ecosystems in the Clouds: Towards Community Cloud Computing.*
[176] See: The East of England European Regional Development Fund Competitiveness Operational Programme, 20072013 Final [November 2007]. Also *Towards Low Carbon Economic Growth;* ERDF

The scheme for the bid would have the objectives of:

- Encouraging take up and use of ICT, using a peer-to-peer network system, which is stable across time, free of licensing costs and attendant legal issues. This strategy designed to side-step the acceleration of the software upgrade cycle, proven to be occurring within the commercial software sector[177], and defray the costs of hardware update (the inevitable adjunct to software upgrade)[178]
- Allowing small businesses to use a set of low cost tools requiring only an Internet browser for initial access.
- Providing a secure peer-to-peer environment for sharing resources.
- Removing some of the costs passed on by large organizations to suppliers in the form of tariffs for access to single portal service, which the companies need, and restrictions on the use of other software.
- Accelerating business partnering for micro businesses through the digital ecosystem, which is designed to mirror social networks in terms of flexibility and trust.

The proposal emphasised that a range of organisations could benefit:

- **VSBs:** Earlier work for EEDA indicated that the very small businesses, a preponderance of all SBs (a) lose core business time on software version change, and may be driven forward to adopt new software versions[179] and new hardware to accommodate them, when what new versions offer is not really necessary to them. This applies to specialist professional software as well as standard office worker software[180].
- **Innovative companies**: would benefit from robust security (ie identity and accountability) services. Paramount for such companies is the need for *privacy of business models and Intellectual Property.* Joint IP in research and development collaborations would be secured to *project participants only*.
- **Collaborative partnerships:** eg bidders for local government contracts would have a space to harmonise processes and share data securely for the purposes of joint ventures.
- **Community-funded organisations including municipal hubs and University departments:** could reduce platform costs, avoid additional audit staff and software to

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Competitiveness Programme, 2007-13 Project, and *Peterborough Sub-Regional Economic Strategy* [2008-2031], report by PACEC Public and Corporate Economic Consultants, [June 2008].

[177] Telephone conversation with Chief Sales Executive of Grey Matter company, specialist ISV for Microsoft products. See also identified positive properties of a DE, Dory and English, DBE Book page 184.

[178] Compare the size of MS Vista OS to previous OSs.

[179] *Network Protocols: the Essential Intellectual Facility* Anna Rosa Gejlsbjerg Jo Stanley, BILETA [2005].

[180] Jo Stanley, *Computing in a Very Small Business,* commissioned report to EEDA [2009].

track presence/absence or out-of-time software licenses. They would inherit heightened security - yet transferability - for public data, which would enhance data-based activities. The parsimony of open source coding within the project, with its profile of stability across time would prove:

- sustainable
- local agent based (for adaptation and maintenance) rather than (central and proprietary) help-desk based, or reliant on expensive proprietary training courses that must be periodically refreshed for the software engineer to remain employable on proprietary systems[181]. The scheme could provide jobs for Open Source Software-savvy young graduates, themselves already members of the alumni socio-economic networks referred to by Tirole[182]

Although a substantial grant for a collaboration between the Peterborough Hub and OPAALS would have flowed from a successful bid, the proposal collapsed during development when the PREP sponsor left the agency, and his second-in-command, who would normally have inherited the bid, took voluntary redundancy.

2.3. The Notion of 'Pitch': Results from a Study of Cambridge Pitches

As discussed above, advice is to target brief and clear information about the OPAALS project to a range of audiences. Although the goals of the OPAALS project are non-commercial - it aims for a community system – nonetheless the ambience of adoption is primarily a market one. Therefore the advice of the VC (market background) was matched against the pitches offered by the Cambridge i-Teams of young entrepreneurs[183] (mainly commercial – some social entrepreneurial), and those of the Cambridge University Entrepreneurs (CUE) *Annual Entrepreneurs £1K Challenge 2008-09*[184] prize winners.

We identified the following basic categories of facts transmitted about the innovations in the i-Teams' pitches:

[181] *Network Protocols* (supra).
[182] Jean Tirole, *Economics of Open Source*.
[183] See *The Cambridge Networks* section in Chapter 3. The i-Team pitches were given at the Cambridge University Technology and Enterprise Club's (CUTEC) *6th Annual Technology Ventures Conference* (11th June 2009), before 250 delegates. The i-Teams Programme was founded in Cambridge with the help of the Cambridge-MIT Institute, and the Cambridge Institute of Manufacturing (IfM).
[184] Sponsored by CUE (Cambridge University Entrepreneurs). Report of the pitches on the CUE web-site [27 01 2009]. See the *Prizes* section in Chapter 3.

Market context; current gaps/opportunities, unmet needs	Current state of development of the innovation
Benefits of the innovation	Likely price and other parameters of acquisition of the innovation once it was on the market
Potential savings in resources	Offers for IP protection if any
Likely revenue the innovation could generate for the developers	Success drivers for the innovation and its scope of application
Functionality of the innovation in a nutshell	Advantage of the innovation over the competition, or if the innovation is entirely new in the field
Future feasible value-enhancing partnerships	Whether/ how the innovation is 'green'

The prize winners' public statements of the pitches for the £1K Challenge used the same facts to pitch, in addition, these categories for specific innovations:

Ability of the innovation to *mobilise existing community knowledge.* eg Gemstone's online database. Information on precious stones. (The Red Gate Software Prize winner)
Service to emerging markets by the innovation. Low carbon device Operation Solar (The Social Entrepreneur prize winner)

2.4 The Q Case Study

The study is outside the region but illustrates a potential use for the OKS to support SME industries with heavy regulatory apparatus, where the playing field is far from level in relation to the corporate giants in their sectors. (See Appendix C).

2.5 Conclusion: Missing Pieces within OPAALS

The regional catalyst will not make rapid progress on the dissemination front without some or most of the following pieces being in place:

- A clear and cohesive view of the OPAALS 'product', and how it ***satisfies an unmet need***.
- The functional layers being ***consensually integrated*** to create an adoptable whole.
- A software ***demonstrator*** is available such that the regional partner can show potential adopters the power of the DE.

- A thoughtful mapping of the ***unique distinguishing features*** (USPs[185]) of the European DE/CCC to the regional needs reported by the regional partner.
- Further ***levelled 'brochure' materials*** should be created for consumption by the various 'market segments' identified in the regions. The market should be segmented by the regional partners and requirements for tuned information for differential pitches passed back to the project.

2.6 Suitable Extension Work for Phase 3 of OPAALS

The Cambridge Regional Catalyst has now assembled a wide contacts list of SME proprietors, municipal officers, people holding positions in government advisory bodies and throughout academe at all levels: researchers, entrepreneurs and investors in local high tech innovation.

This is a critical time in UK politics. Accelerating rates of redundancies have given citizens working reduced hours or not at all space to consider and start to repair the civic project[186]. Thinking is concentrated on what ought to be core and essential *public* expenditure, and what should be jettisoned. Beginning with the Banking sector, citizen challenge to the values held by the corporates is under way, and straws in the wind of revival of societal cohesion and self-help are evident across many sectors[187].

If OPAALS is to gain exposure in the East of England, a networking project should now begin, centred about Cambridge University. The activity would be to hold *small* college lunch meetings of contacts - three persons per meeting plus the Cambridge catalyst, at frequent intervals. From this, and chaining introductions an emergent network of thinking about essentials in a time of economic constraint may develop. As candidate for the electronic platform for this cluster, Twitter is one obvious communications means, not least because numerous local SMEs have now begun to do business through this means, so it is familiar. As and when the OPAALS platform becomes available, the Twitter users could be encouraged to transfer their activities to DE communication means.

During development of this informal network:

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185 Business term: Unique Selling Point.

186 See statistics and theorisation in Putnam, *Bowling Alone.* Also the communitarian writings of Michael Sandell, and the diagnoses of pathologies within organisations that Richard Sennett makes.

187 Work being done for another project, involving the corporate supermarkets and contracts for farmers in the food supply sector, East of England. Stanley 2007- 2010.

- The specification detail for the OPAALS platform should come into focus for the OPAALS developers, since it would have the competition of the popular social network platform to work against.
- The benefits of the OPAALS platform should become clearer for the users, thus providing a bottom up route through to adoption.

Appendix A

The 'Selling Sheet', developed by Jo Stanley under Guidance of Walter Herriott, CEO St Johns Innovation Centre Cambridge.

The Digital Ecosystem (DE) and the Open Knowledge Space

Who Needs the System?

Any organisation needing to share knowledge securely or disseminate information and interact with recipients.

- Small businesses, community projects, specific industries, such as the construction industry, with its network of designers, trades, materials suppliers, and professional support.
- Central government departments and regional government hubs: the Shire and City Halls, and the services they are responsible for, schools, libraries etc.
- The innovation support hubs such as the Peterborough Eco-innovation Centre, and the Cambridge Science and Business Parks.

What are the Unique Features of the System?

The European DBE project, and daughter project OPAALS, bring together a unique blend of the powerful properties native to a digital network. The ecosystem was inspired by a desire to enable small companies in Italy to establish networks of easy-access supply chain information for the trades. Early trials targeted the distribution of tourist information.

- The system is ***community-oriented***, and built according to Open Standards using Open Source software[188].
- The system runs distributed and peer-to-peer across the Internet, with a design for routing and re-routing transactions on the network that ensures ***no single point of failure***. A computer configuration comprising a server and client machines, on the other hand, has a the potential for a central point of failure.
- The large commercial servers represent ***single points of control.*** The European Digital Ecosystem project is committed to democratic principles. Small companies are not charged fees by intermediaries for advertising their goods and services; this service is provided via the system's **Open Knowledge Space** (OKS)**,** which also offers free tools to enable sharing and editing documents, and developing web objects. ***Digital Ecosystems are owned by the users;*** they cannot be easily shut down as for

[188] **Open Standards** simply means that there are no interoperability barriers between the various elements of software that go to make up a computer system. An interoperability barrier is usually caused by two pieces of software from two different publishers not working together. **Open Source** means that the software code is freely available (ie 'open') to be adapted by an organisation's Software Officer to her specific needs. This is because the authors of the code, whilst acknowledging their copyright, have devised licenses, such as the General Public License (GPL) or the Creative Commons license, to release their code to the public at large free of charge. This type of license needs no renewal, and there are few legal obligations in its use. The only one is normally that the code must never be 'closed' by a user, but be allowed to flow freely through the user community, always without charge or obligation.

example a manufacturing plant can be. As a consequence, a DE is ***highly sustainable***.

- Clearly if an organisation's data is to travel via the Internet and be held on the Web, then a rigorous security system, known as ***a trust and identity model*** must be developed. This implies that everyone who has access to the system is vetted and vouched for many times over before being admitted to data held on the network.
- The system is ***low carbon compliant***. Being fully distributed, the DE can be 'fuelled' by half a dozen modest-sized machines in the network, avoiding a fuel-hungry, coolant-requiring 'server farm' configuration of computers.
- The DE transactions design enables a company to ***retain its own autonomy*** by being only loosely coupled to the network. This was the original goal of the network models called 'Service Oriented Architectures' or SOAs. However, the commercial offerings in this field have not as yet fully achieved these goals. The DE project makes this specification a top priority.

Where has the System been Tried Before

- The interface for the system, Guigoh[189], was developed in Brazil under government sponsorship, to be released for around 8,000 Brazilian school children to use. This source has generously agreed to donate the software, which is an Open Source build, to the DE OPAALS project for further development.
- An Indian team of researchers has studied the main knowledge requirements of Indian farmers – plant pathology information, for example, figures large amongst these – also weather news and reports of advances in agricultural machinery. The team built their specification around these needs. The system has been trialled and accepted in many regions of South India.
- Teams in Ireland are currently working on the requirements specification for the biotechnology industry around Dublin.

How did the Digital Ecosystem get its Name?

- This is a biological metaphor that highlights the interdependence of all actors in any business environment
- These must "co-evolve" their capabilities and roles. This the DE hopes to enhance and potentiate.

Amongst the ultimate goals of the eco-system are these:

- to be self-organising and self-optimising
- to show the ***intelligence*** to 'learn' about a region or industry
- to store company descriptions in a Business Modelling Language (BML) and..
- thereby determine the economically efficient combinations of agents in a given region to supply products and services.

The DBE is the largest EC research investment ever in Open Source Information and Communication Technologies (ICT) for e-business

[189] A species of small monkey, illustrated in the icon for the interface.

END SELLING SHEET

Appendix B

Minutes of the Peterborough, OPAALS, and Cambridge SME Meeting at Lucy Cavendish College Cambridge, 5th Aug 2008

Those present:

Will Spinner: Peterborough Regional Economic Partnership, Paul Krause, and Amir Rasavi: Surrey University, Chris Thomas: Milton Contact. Chaired by Jo Stanley, Lucy Cavendish, Cambridge University. Hereinafter: WS, PK, AR, CT and JS

Meeting started at about 12.15 pm: Morning Session

The meeting opened with introductions all round.

PK then took the floor. He began with a statement of the mission of the OPAALS project, which is sponsored by the European Commission, starting with an explanation of what lay behind its title: *Open Philosophies for Associative Autopoietic Digital Ecosystems.*

What needed some explanation were the terms: 'autopoiesis' and 'digital ecosystem', ('associative' was omitted for the time being). He emphasised the implications of *openness,* which is the hallmark of the project.

After a brief definition of *autopoiesis*, he told us how, from its cell biology roots, the theory had subsequently been transferred to application in studies of social and business organisation and thence to digital systems. He also described how OPAALS took from the theory the concepts of ***self-organisation*** with ***self-repair*** (***self-maintenance***) to apply the digital infrastructure development**.**

PK linked these elements to the openness referred to in the OPAALS title. An 'open' system in OPAALS terms implied a distributed, (networked) configuration, without any ***single point of control*** (SPC) or, by the same token, any ***single point of failure*** (SPF).

Moving to digital aspirations for the national economy, he described how the UK government set great store by the use of Information and Communications Technologies (ICT), notably use of the Internet, to grow the economy by supporting businesses.

The digital ecosystem, however, provided an advance on the current government thinking on how the Internet is actually used. The DE's particular benefit stems from infra-structural support for *a balance* between the essential *local autonomy* of a business, meaning the preservation of its private data, and the natural desire of businesses to collaborate and share ideas.

The current use of the Internet by large players does not support the notion that business data should only be released as and when *and if* the owner company so desires. At the moment the balance has tipped in favour of the large firms, who can demand and get a good deal of the data that identifies the value of a company during the course of day-to-day business transactions with that company.

This flaw in current Internet use patterns is particularly well-illustrated in cases of personal data, where companies such as FaceBook accumulate masses of personal behavioural data from countless individuals. The mining and analysis of this data provides value for FaceBook, in exchange for relatively little but minor publicity for the data donor.

PK then focused on his and Amir's work with long-term transaction computing, providing examples. Planning a holiday, for instance, has a multiplicity of requirements (accommodation, travel, etc). These needs can be rendered digital as a *composite transaction,* which can take a long time to finalise and needs specialised technical treatment[190]. A company such as Expedia will facilitate the organising and booking process for end-users, but the tariff exacted by Expedia from the participant small businesses providing the services (of the order of 20%) is beyond what the little companies can pay and still remain profitable (which would be nearer 2-3%). Expedia represents a ***single portal*** to

[190] The technical details (see joint papers by AR and PK) are best left for future meetings or correspondence.

holiday construction services, but a SME will probably find it too high a barrier to adoption for what would otherwise be a very helpful scheme.

The DE, on the other hand, starts with the premise that in such transactions, there should be 'fair shares for all' the participants in the business community. Thus the intense technical effort of the past 5 or 6 years of the DBE project then OPAALS has gone into the realisation of this goal *at infrastructural support level*[191].

PK then explained that just as important as deriving principles from the theory of autopoiesis is the use of evolutionary models (of which Surrey has made a particular study). Here the role model for a balanced digital system is a ***healthy*** natural ecosystem.

The best of these natural organisations have a population 'tail' comprising a large number of species, each present in small population numbers (possibly the species is niched out into especially demanding habitats). These exist alongside a small number of species present in very large population numbers. These species are particularly favoured by current environmental conditions.

If conditions change, wiping out the current dominants, then it is the tail that provides the best chance of saving the system from tipping into decline, since it harbours the genetic source of innovation to respond to the new conditions[192].

Less healthy scenarios are where a dominant effectively produces a 'business monoculture'. If such a firm is taken out of the eco-equation, and there are no tail species for genetic 'experimentation' with changed conditions the ecosystem will fail. In industrial organisation, the presence of super-dominants[193] can be regarded as an environmental condition that impacts all other business species.

Paul then explained that OPAALS sought its own internal balance by addressing social and economic, as well as digital aspects of the new knowledge-based economy that we are experiencing growing up around us.

A key factor when living in a world 'organised' by dominant firms is that self-organisation tends to be difficult to achieve. The current Internet use models fail to support local autonomy for the firm, and the so-called sharing/cooperation zones are homogenised to the desires of the dominant participants. Thus, conformity rather than diversity results. This model promotes the possibility of single points of failure, and more importantly, single points of control.

PK harked back to the original Tim Berners-Lee aspirations for the Internet, and his appreciation of the importance of the interfaces between person and computer, and between computers themselves. The Surrey research indicates that Google, Facebook, Amazon etc represent *partial* successes in the deployment of Internet-based services. However, OPAALS' focus is the health of the SMEs across Europe – the 'business tail'.

WS interjected that these ideas would be of interest to the banking industry, whose analysis of customer habits steered marketing and customer approach practice. CT inverted the 'dominant takes all' argument by pointing out that usage patterns of web-sites established on behalf of SMEs benefited by utilities such as hit-tracking, which the dominants provide to the site-maker.

Paul's key example of dinosaur demise now attracts well-substantiated new theories of a gentle decline in those natural dominants, over-writing earlier (1960s) theories which favoured big-bang extinction by meteorite hit. This would seem to indicate that in a natural ecosystem, even the demise of the dinosaurs, represented a gradual process of evolution towards replacement out of the genetically innovative tail, rather than a monoculture extinction creating a void into which 'tail species' populations could expand.

Digital Solutions under OPAALS

[191] See the websites of the DBE mother-project to OPAALS, where a short Flash movie gives a simple graphic image of the way the DE (as we now call it) is intended to work.

[192] Supported by biological theories of *founder* and *relic* populations, which may respond quickly to selection pressure.

[193] Large firms with greater than 70% of market share are known as *superdominants* in the European Court competition law cases.

PK explained that (1) the effect of major players' cost models on SMEs and (2) the casual surrender of data by the SMEs – possibly with a view to SME acquisition by a dominant - could both be mitigated by the creation of *software agents* acting on behalf of the SMEs. These agents would enable (long term) transactions without tariff and without any requirement to surrender data.

In addition, the configuration of an OPAALS network would avoid a requirement for heat-generating and power-wasting servers, by using surplus power from PC-grade machines, which would distribute the transaction workload (shared capacity)[194].

WS next voiced his requirements of us, explaining the tasks meted out to the Peterborough team. PREP which he manages and represents. PREP is one of nine sub-regional partnerships in the East of England – sister to the Greater Cambridge Partnership, amongst others. The core goal of PREP is to make Peterborough more attractive to knowledge-based innovative firms looking for a home, to attract inward investment and hence promote growth of the town in a desirable direction. This objective required examination of present industrial clusters[195]. A primary issue is exactly *how* to intervene in the economy of Peterborough to effect these changes.

The meeting broke for lunch on the important challenge by CT to JS to explain the role of IPRs in all this[196].

Meeting resumed at about 2.15 pm: Afternoon Session

The gathering then addressed examples, problems and solutions, which their collective experience had thrown up.

PK resumed the matter of community-based open systems by describing his experience in the health sector. Currently there are concerns regarding central government's loss of very private data belonging to individuals. Paul described a model whereby each of us keeps our own health record, permitting selective access to relevant parties. (Encrypted records subject to grant and revocation of rights to view, ?alter?, etc a person's own data). JS pointed out that informed choice as to institutional acquisition of computer solutions ready needed the advice of a well-trained in-house Chief Information Officer (CIO).

CT suggested we consider the issue of who *owns* the network, and takes responsibility for how it functions.

PK commented that trust and accountability (for actions on data) are critical[197]. He added that ownership of the network must be by the community. This had some drawbacks. His example was the release of the (secret) site address of a protected plant species, which Wikipedia had rather insensitively refused to remove from their site when requested to. The Wikipedia principles set classifies any such removal as 'censorship'. (We didn't think the plant concerned would look at it that way).

JS brought up the fact that Peterborough is categorised as a deprived area, and ripe for regeneration. The meeting then reviewed the potential benefits of a 24/7 culture, supported by a DE, for cohorts such as: students wanting to make a little money at odd times, the disabled,

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[194] Distributed (network) models require the utmost protection for users, hence robust authentication and authorisation (ie log-on) systems and skilful checks on the identity of users. Again, the technical details of these aspects of OPAALS are left for another day.

[195] Food-related industries, advanced engineering, and a range of eco-industries: processing waste, waste water, addressing energy issues (turbine technologies) etc etc.

[196] JS notes that although the Peterborough of [2005] housed around one fifth of the VAT registered companies in Cambridgeshire, it obtained only 6 patents as compared to the whole county grants of 190, making its patent rate (patents per thousand companies) – ***which was 0.57 in [1995] and then double the county rate*** –a poor 0.13 in [2005], as compared to the whole county rate of 0.71, (PACEC analysis of Patent Office figures). JS will be inquiring what happened to the Peterborough industrial scene over the last decade.

[197] The OPAALS Waterford partner, under Paul Malone, are developing trust and accountability models and implementation

mothers tied to families at home, early retirers who might be in process of becoming isolated, or want to work[198], and those isolated or house-bound by any circumstance whatever.

WS commented on the barrier to social and business activity that isolation represented, and we looked at how a DE might best serve to mitigate such defects in the Peterborough economy.

CT was keen on the concept of 'de-isolation' (JS term) starting in the schools. Large software publishers (notably Microsoft) offer introductory licenses to schools already. He believes that from the schools the culture spreads outward into the community.

CT and PK both had experience of encountering illegal software (license used inappropriately, or run out), and Paul and Amir emphasised that OPAALS software was 'open source'; ie anyone can read (and modify) the code, and it requires no license and no tariff[199].

Possible Actions

PK suggested that Peterborough might boot-strap a system whereby some community web services were offered as starter tools. The idea of 'sending a request' to the virtual editor for supply of these services would be an introductory analogue to a DE. Tools would include word processors, spreadsheets, and a pool of office support.

AR put forward a balanced view of a system such as Amazon. Here a person or SME could sign up as a parcel deliverer, thus enabling Amazon to side-step many of the problems that Royal Mail experienced. However, an SME wishing to avail itself of the list of deliverers could not access the specialised network that Amazon had built up, and then kept close to its chest.

PK suggested a yellow book of providers offering a format that directly compared costs of the offering.

CT was eager for us to arrive at a minimal specification to implement.

PK felt that it would be most useful if Peterborough could locate some use cases where there is unrealised economic potential, and to which the Surrey team might bend its collective mind.

CT suggested that a way be found to incentivise people under the stimulus the services already available, and then disseminate a role model business which joiner SMEs might copy, modify or ignore – the choice would by theirs.

JS suggested (cynically perhaps) that the greatest drain on the benefit system might be a place to start.

WS pointed out that funds in such an enormous undertaking as regenerating Peterborough were always likely to prove inadequate, therefore funds would be deployed at points of critical need, inevitably leaving gaps.

CT suggested investigating the mini-grant (micro-support) model, which has been used successfully to boost SBs and start-ups across India and Africa.

WS mentioned the PREP use of indicators for need to intervene, and that there was no full set of interventions, but instead the strategy was to attack where key needs were felt.

JS described the '4 accounts' evaluation scheme that the Rome (economics) partners in OPAALS were developing. Namely that a scheme be assessed under:

- *The Financial Account*: net return or cost to 'investors'

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[198] The cohort referred to in this year's Intuit report on small businesses as 'the un-retired'.

[199] More strictly, OPAALS is mainly *Creative Commons* licensed. Simply put, the license is 'given to the public' for free. There are many flavours of OS license; most have conditions. The most vehemently upheld condition is that if software begins life as OS, then as it propagates through a community, the code must never be closed by one user against other users. We use Creative Commons for all project materials ***that are not code***. For software we use any accepted OS licence that is approved by www.opensource.org. It is not possible for any OPAALS partner to stop another OPAALS partner from releasing their code under GPL if they so wish, even in cases where the work is collaborative. This is because GPL is the most 'open' of the OSS licences, and it is viral as well. So many people prefer to use LGPL or BSD or other similar ones that are not viral. That is acceptable, but if a partner is more 'radical' and wants to use GPL they should not be prevented from doing so.

- *The User/Consumer Account*: net benefit to users as consumers of services provided under the DE
- *The Economic Development Account*: micro- and macro-economic net benefits to productivity, growth and employment.
- *The Social Account*: social /community impact, net benefits in terms of social capital[200]

PK pointed to the benefit of accelerating finding a business partner by use of the DE.

CT suggested beginning with a prize competition in schools to stimulate innovative activity early in careers.

WS then outlined the 4 Strategic Objectives for Peterborough:

- An ideas economy
- An adaptive economy
- A specialised economy, and
- An open economy

Out of a welter of 122 actions that might be taken he had distilled 32, which could be assigned to 7 families. He commented that the town would benefit from having a University, and mentioned the recently established Peterborough University Centre.

JS pointed out that to bring a *concrete* University up to research level might take decades, and PK mooted the alternative of a '*Virtual University'*, and making available social networking tools.

The meeting then agreed that DE concepts and provision would need aligning with current objectives and initiatives in Peterborough, but that a DE would enable a genuinely emergent social and business organisation.

WS suggested that a first step would be to use an existing EEDA-style proposal form as a frame for our joint agreed plan, because it prompted for specific items required from OPAALS.

PK visualised an initial Open Knowledge Space to (1) expose eco-expertise, (2) search for business opportunities and (3) thereby attract further knowledge inputs to build up the stock.

AR described the eminent suitability of a DE for virtualisation, sharing knowledge and providing the SMEs with the means to extend their markets. He asked whether we had means to establish how many local Peterborough companies had access to and used web services, and explained the limitations of a web site, as compared to full use of web services. Of all web service-style models, a DE was superior. Facilities such as PayPal and the shopping carts had to be paid for, and in effect did not offer all the consumer thought she was getting (eg a fully protected transaction).

CT offered a searchable database for local companies, which he has compiled.

Surrey suggested that a prototyping project might be completed within 3 to 6 months, and warmly welcomed the idea of a Peterborough case study. The cost of the study would be of the order of £30 – 40K plus overheads. WS thought he could put Surrey in touch with possible sources of funding.

WS has outputs to achieve for measurement by EEDA, and any scheme OPAALS offers *must map to such outcomes*.

JS commented that strong common ground between OPAALS and Peterborough was a requirement for *sustainability*.

CT summarised that any case study must address the needs of (1) education, (2) the disadvantaged and (3) the high flyer companies.

[200] D11.1 OPAALS papers

All agreed that the content of our discussion contained no confidential material, but that we might all edit the minutes.

WS concluded by thanking us and declaring the time in the meeting well-spent.

The meeting closed at around 3.20pm **Recorder: Jo Stanley**

Appendix C

The Q Case Study[201]

Q is a small privately owned company based in a north of England industrial town, established in January 1996. The company name derives from its primary activity, the manufacture of Benzalkonium Chloride (BKC), a member of Quat (Quaternary Ammonium Salts) family of biocides.

BKC is a well-studied raw material with a long history of safe and efficacious use against bacteria and fungi, and is used mainly in the manufacture of disinfectants.

Existing satisfy regulations include:

- Stringent independent testing in accordance with British & European microbicidal standards.
- Livestock biosecurity tests and approvals from DEFRA for use against contagious viral diseases such as Avian flu etc, etc
- 'Low Environmental Impact installation' certification, setting a precedent in the chemical industry.
- ISO 9001:2000 Quality standard certification to ensure that its team of scientists and sales staff worked closely to uphold its commitment to Product Quality, Customer Satisfaction and the Environment.
- Q biosecurity products are currently approved or undergoing registration in over 42 countries worldwide[202]

UK biocides sector represents an area of high potential growth for SMEs .

> *However, SMEs struggle to compete in an environment dominated by multinationals and where over-regulation of the chemical industry which has caused depletion of reliable local raw materials suppliers.*
>
> *In all this the most serious threat to SMEs in this sector to date comes from European regulations. Continuing supply into EU countries now requires products to be registered in accordance with the Biocidal Products Directive 98/8/EC (BPD). The BPD is a colossal complex piece of legislation requiring a full team of regulatory experts to decipher it and keep up to date with changes.*

Currently 4 of the 6 research scientists at Q are having to work through the regulations instead of focusing on core business[203].

Registration of Q's raw material alone, even if limited to 10-12 application areas, could potentially leave the company facing a bill of £ 4.3 – 6.56 million. A further £20,000 fee is estimated simply to register each of its 30-40 proprietary user products; supporting tests and studies will take this figure to approximately £200,000 per product. In addition to these costs are staffing costs associated with registration dossier preparation, legal and consultancy.

The BPD thus appears to present an insurmountable hurdle for SMEs. Q fears that:

- 'The whole BPD regulatory apparatus will thus be funded (and controlled) by multinational corporations'.
- 'The innovative edge for which the UK is renowned will be lost under such restrictive conditions, as research into new/more effective/safer/niche biocides becomes commercially unjustifiable'
- 'Registration costs will inevitably be passed onto the consumer, in the form of price increases in the region of 10-30% for most products'

[201] This report relies on a Sunday Times Report.
[202] Biosecurity is a combination of workplace controls and use of biocidal products to control microbial proliferation to safeguard livestock health and public food supply.
[203] Interview with Q's founder, CEO and chief scientist. Interview 61.

An ***open pooling of regulations knowledge*** would short-cut the company to vital ‘to do’ lists for compliance with new regulations. According to Q’s spokesperson the major companies have such a repository, but:

- Firstly, there is a £2,000 joining fee
- Secondly Q is unsure what will be the fate of commercial data they are required to submit to the pool organisation.

A platform such as the DE/OKS might encourage an open forum for regulatory knowledge and advice from the regulators to the SMEs.

Otherwise the firm believes that registration costs are a prescription for industrial consolidation as may have been the case in the pharmaceutical industry.

Chapter 3

Intellectual Property in the Cambridge Technopole

3.0 Cardwell's Law and the Future of the Technopole

> *No nation has been technologically very creative for more than an historically short period[204].*

This chapter explores the *production of knowledge* in the Cambridge Technopole[205] high technology industries[206], the *acceleration of knowledge transfer* across the Technopole, and strategies for *knowledge diffusion* beyond the Technopole. The report gives an account of *incentive schemes* such as prizes and seed funding, and next stage Business Angel and Venture Capitalist investment in the high tech industries. It records the changing role of IPR policy within the University. The Cambridge networks are explored by sector and the maturation stage of ideas. Maps record the relationships between firms from their inception and *company family trees* of their histories[207]. Extensions of this work by sociogram techniques illustrates the linkage amongst *individuals* in the Technopole and demonstrates the stored intellectual and social capital in the city. Reciprocal or Interlocking directorships amongst Technopole firms provide an example[208]. Work on the imprinting of parent firms on their child companies using a biological simile is examined[209]. The maturation of ideas with utility is followed from inception, along mutiple trajectories, to licensing, or company start-up[210] or spin-out. Some of these companies grow, remain in the hands of the founders[211], go on to acquire other companies, and establish themselves (by Marketing or Design Offices) in other countries. Others exit the market by trade sale[212], or market flotation (Initial Public Offering - IPO), or failure.

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[204] D.S.L Cardwell *Turning Points in Western Technology,* [1972].

[205] Technopolis: society dominated by technology (OED): taken here to include the University, its spin-outs and local entrepreneurial start-ups.

[206] Principal sectors being: biomedical/biotechnology (alias meditech), research and development, chip innovation, wireless, engineering,, communications and media.

[207] The 'annual rings' mapping of companies and their progeny as family trees from 1950 to 1985; Segal, Quince and Partners, *The Cambridge Phenomenon: The Growth of High Technology Industry in a University Town,* [1985]. The map shows the total population of firms up to 1984. The notation gives the University Departments from which spun out, their sector, and whether active or no longer trading.

[208] Work of Shailendra Vyakarnam, CfEL in the Centre for Entrepreneurial Learning (CfEL) at the Judge Business School. Web site last visited [June 2009].
The effect of social capital in new venture creation: the Cambridge high-technology cluster. Myint, Y.M., Vyakarnam, S. and New, M. [2005], Journal of Strategic Change, 14: 165-177

[209] *Imprinting-Deprinting-Reimprinting: A Process Theory of Intergenerational Learning and Spin-off Entry,* Simone Ferriani, Elizabeth Garnsey and GianniLorenzoni, CTM 2007/1, [February 2007].

[210] The Instuitute for Manufacturing (IfM) definition of a start-up is: having less than 50 employees, and being less than 10 years old.

[211] For example *Autonomy,* founded by Michael Lynch.

[212] A recent prized example being the acquisition of Domantis by GlaxoSmithKline in the fourth quarter of 2006.

Beyond the Technopole successful start-ups registered in Cambridge may open offices within a few years in Boston, Singapore or California.

3.1 Prospects for Cambridge

> *"The [Economic] analysis suggests a somewhat bleak picture for the Cambridge cluster. Overall the cluster is losing ground to its competitors, particularly London. At a sectoral level, the cluster is strong in stagnating areas such as life sciences but weak in emerging areas like Web, Mediatech and Clean Energy."*[213]

3.1.1 History Matters

Throughout 2009 Cambridge celebrates what the banners hanging from the town lamp posts proclaim to be '*800 years of invention'*. Yet the inception and early history of the University indicate its purely pedagogic purpose rather than any research ambition.

Its origins are with escapee scholars from hostile citizens at Oxford who, migrating to find a safe haven, somehow fetched up in Cambridge[214]. The serendipity of the case is emphasised when we learn that Northampton was a strong early candidate for lead regional university, indicating the importance of path dependency amongst the parameters of complexity leading to the current dominance of the city's University[215].

Medieval students initially studied a 'foundation course' in arts – including grammar, logic and rhetoric. This led on to arithmetic, music, geometry and astronomy, and with luck, degrees of bachelor or master. There were no professors; teaching was conducted by *masters* who had themselves passed through the course and been licensed by the corpus of academics (the *Universitas* or University).

In the 17th to 18th century, the mathematical backbone to innovation was consolidated in the work of Sir Isaac Newton [1643-1727], and students pursued various scientific inquiries. Much later, after 1945, the University was able to capitalise on advances made by Clerk Maxwell and Darwin, and subsequently J. J. Thomson, Rayleigh and Rutherford. This was the period of physics and physiology, and was followed in the 1960s by the molecular biology of Watson and Crick.

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[213] Library House Report, *Looking Inwards, Reaching Outwards, The Cambridge Cluster Report* by Ed Hugo *et al* [2007], p. 23. Library House was, until its recent demise, a company acting as the investment antenna of Cambridge. It was strong in economists, and reported on national and international trends and opportunities for local high tech firms. It is reported to have considered itself a local Think Tank of some heft. See also *Funding Technology, Britain Forty Years On* Gill, Minshall, Pickering and Rigby [Jan 2007], and interview11.

[214] http://www.cam.ac.uk/univ/history/index.html

[215] See also the potential at one early stage for the cathedral city of Peterborough being a contender. Interview 29 with Library House representative.

At the moment bio-medical science[216] is the dominant research field. The influential Cambridge Consultants Ltd (CCL) has recently expressed strong interest in Cleantech and low carbon-related technologies. Telecommunications is splitting into a number of new disciplines, wireless technology innovation being strongly represented in the Technopole[217].

3.1.2 Modern History: Seeking The Phenomenon

> The University has a reputation for innovation in hard science. Its performance dip of late is likely due to the rise of the 'soft sector' with the advent of Web 2[218], and the decline of Biotech investment. One specialist Biotechnology investor reports that the so-called Cambridge Phenomenon was a function of ***both*** place and time[219]. The Cambridge of 1985 to 1999 was truly phenomenal, a cluster of 250 meditech firms, employing 10,000 people did phenomenal things, principally in drug discovery, but also in cell therapy and epigenetics[220].

3.1.2.1 Defining the High Tech Firm

These are the firms founded in *emergent and newly diffusing technologies*. Here high-tech refers to ***firms with high-tech inputs*** (1) an R&D budget (2) above average proportion of science and technology employees (3) firms that by their own activity description use the emerging technologies[221].

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[216] Otherwise '*Meditech'.*

[217] With at least one local specialist investment house supporting this field.

[218] Cambridge's share of deals made by the top 20 European clusters came down from 9.3% in 2005 to 5.6% in 2007. The new emphasis on '*soft innovation'* notably in Service and Retail, and '*Mediatech*' is blamed for this. Whereas the Cambridge Cluster has shown very limited activity in these sectors, other major European clusters have shown a significant rise.

[219] Interview 19. The same interviewee is not sanguine on the prospects of attempts to re-create such clusters elsewhere 'by government intervention'.

[220] Changes in cell phenotype by means other than changes in the DNA.

[221] Alex Drofiak and Elizabeth Garnsey *The Cambridge High Tech Cluster: resilience and response to cyclical trends,* Institute for Manufacturing (hereinafter IfM) Report No: 2009/01, [January 2009] Report for IPGC (EPSRC grant IPGC RG44/02 NMZM/ 072).

Through the 1990s and 2000s both biotechnology and R&D firms experienced steady growth with an increase in firms and job numbers[222]. In the recession of the early 1990s, a small cohort of technology start-ups achieved higher survival rates than those started in boom years. The boom in software between 1992 and 2005, and the subsequent decline in local firm numbers between 2002 and 2006 reflects the creation of large numbers of *short-lived software firms* during the good times[223].

The R&D sector continues to grow. Meditech innovations, maintains one entrepreneur-cum-VC, are 'done by individuals'. However, such is the scale of the pharmaceutical regulatory apparatus that by the stage of clinical trials, if not before, major funding is needed for this type of innovation in order for it to diffuse any further. At this point funders look for very strong proof of concept by possession of a patent before entertaining the possibility of investing funds in the company.

After 2004, the number of technology start-ups in the Technopole dropped (as compared with the Cambridgeshire county VAT registrations for all new firms), and numbers of exits[224] increased, indicating that Cambridge tech-based firms were experiencing pressures specific to high tech.

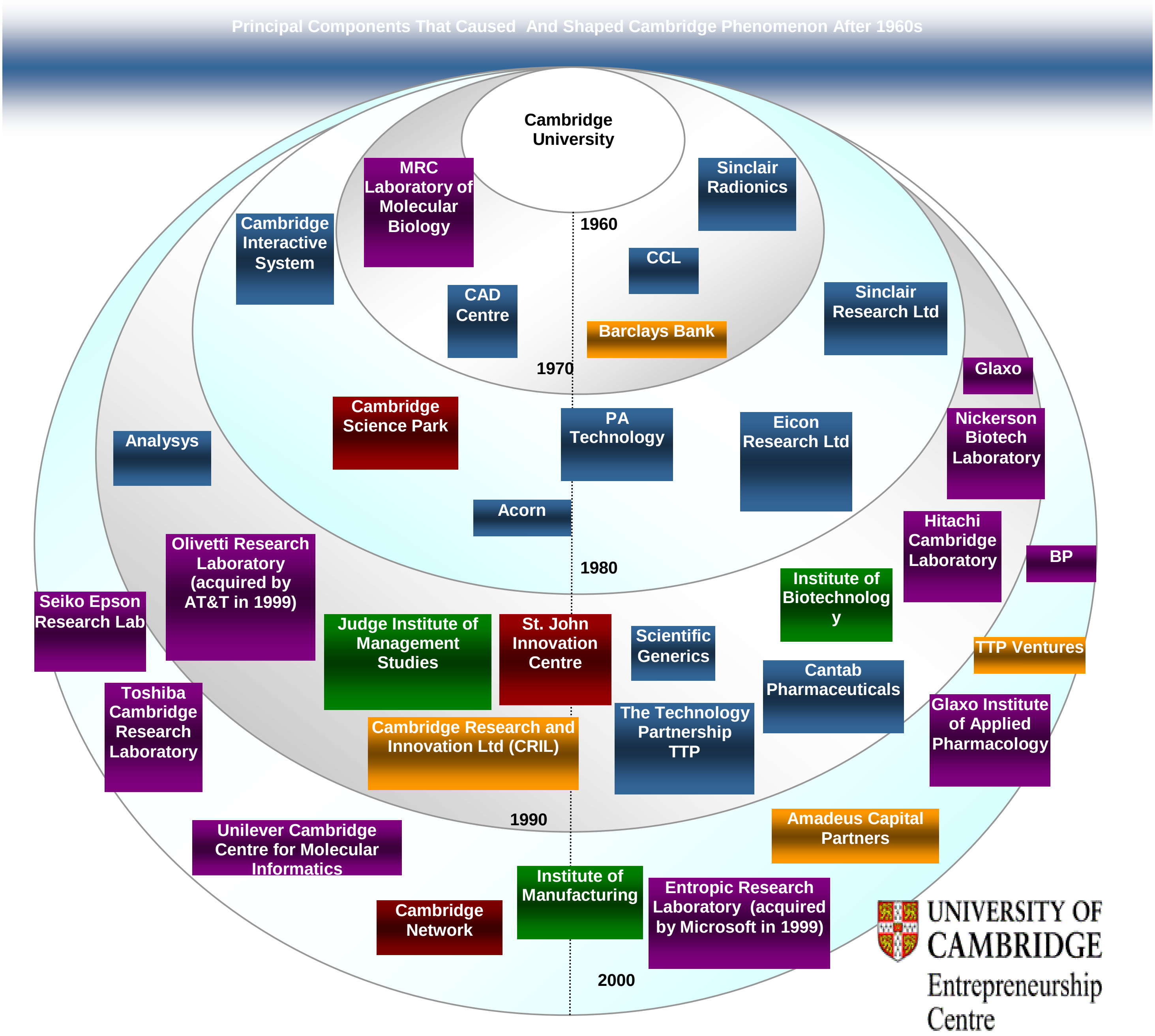
For a good idea with utility in the high tech field to go any further, the driver is almost invariably substantial investment. This can be for two reasons: firstly development costs and time to develop and test further may stand between the idea and the market (meditech). Secondly, the idea may be 'hot' and the company requires immediate capital to expand fast and capture the market (computer technologies).

The next section deals with the investment landscape. What is striking is the way the Technopole has created a *formal structure* to allow investment to happen, which is nonetheless based on an *informal social network* having the properties of high transmission speed and vigor.

The following diagram plots the growth of Technopole Institutions across time. It holds much of the information recorded in the original SQW book, *The Cambridge Phenomenon* [1985].

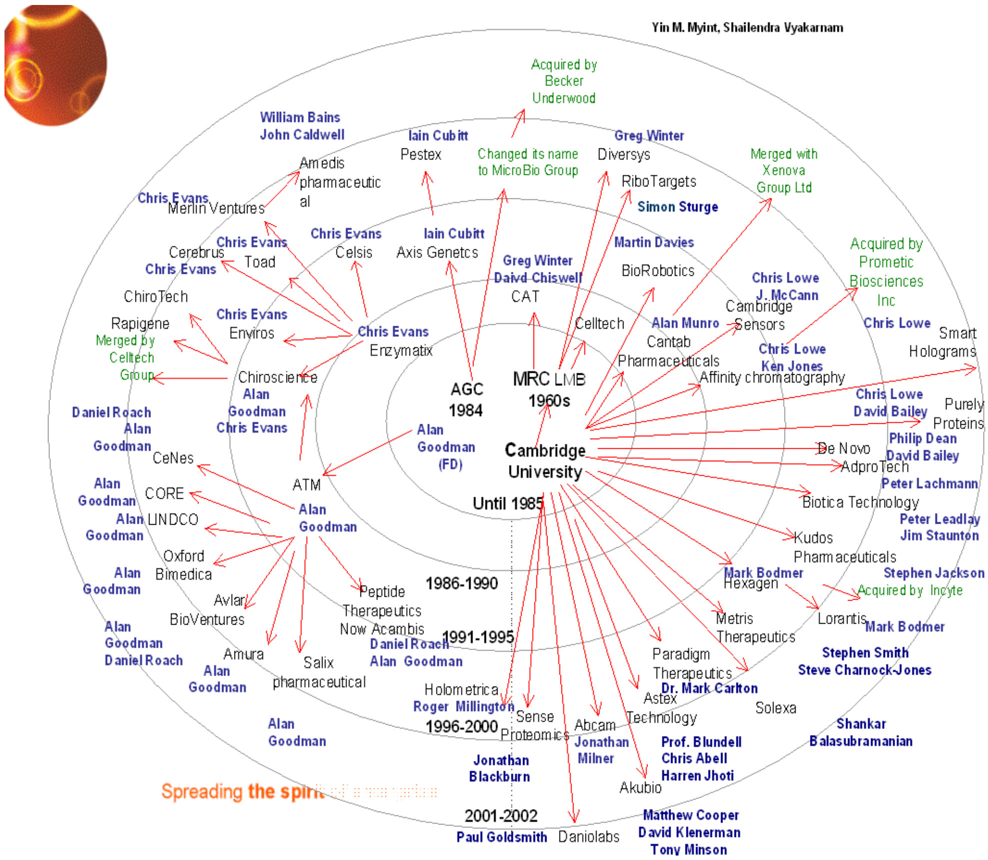
[222] The 2007 Library House Report gives these figures. There were 108 venture-backed companies, of which 36% were in the Healthcare & Life Sciences sector.
[223] Garnsey et al [2009]. For comparision snapshots in time see: Garnsey, *The Cambridge Phenomenon Revisited*, [1997] and the report a decade ago: Garnsey and Lawton-Smith *Proximity and Complexity in the Emergence of High Technology Industry: the Oxbridge Comparison.* Geoforum vol 29, no 4, 433 [1998].
[224] Firms leaving the market through failure, going public or a trade sale.

The diagram follows the SQW style of annual rings to show developments. It was used with kind permission of Shai Vyakarnam and Yin Myint. It shows a liberal selection of institutions, not just companies, but also University Departments and investors.



Academics have developed their own annual ring structure in housing depicting when various members of the community joined the University. In the 1960s, property was relatively cheap, and academics bought spacious houses with grounds. The 1970s and 80s joiners could only afford terraced or smaller semi-detached houses in less central areas. Joiners in the 2000s are likely to live in the new town of Bar Hill, 7 miles west of the city.

The following diagram picks up the story entrepreneurship at 1985, and follows thorough serial entrepreneurships of people and their companies to the start of the twenty-first century.



Diagram, courtesy of MyInt and Vyakarnam, CfEL

3.2 The Constitutional Planks of the Technopole; Science and Business Parks

3.2.1 The Core Technopole: How Big?

Walter Herriott, newly retired CEO of the St Johns Innovation Centre attempts to beat down the over-estimates for the number of companies:

> 'I think everybody now accepts that the 3,500 figure [for Cambridge high-tech companies] is a gross over estimate. 'On a very purist definition, the estimate is about 900 and on the broader definition that we use at the Innovation Centre around 1,500. However, I don't think anybody has done an equally scrupulous evaluation of the 7,000 companies in Silicon Valley!
>
> Comparing Cambridge with Silicon Valley, Shanghai or even Malaysia is clearly unfair if only on the basis of population. It's like comparing a kingfisher with a vulture - and large may not always be beautiful or desirable!'[225]

Cambridge began to spin out companies earlier than, Silicon Valley[226]. A prime mover in that early development of the Valley was University Professor Terman, a Stanford engineer. Silicon Valley moved faster and commercialised innovation far more effectively[227]; its successes are manifest as huge corporates. In Cambridge production of commercialized product is transferred beyond the town itself, where small companies proliferate.

Cambridge remains a smallish provincial town complex with production and the larger laboratories situated elsewhere. Koepp records a number of rejections of planning permissions for schemes that would dilate industry in Cambridge. This constrained status was due in the main to local government policies as to how the area should develop[228]. To this day the road structure remains inadequate[229], and there are arguably better train services to neighbouring Huntingdon, both from London and the North and Midlands. House prices in the last decade effectively bar ownership by academics who work in the University and the spin-outs[230]. The Library House Report indicates that broadband delivery could also be upgraded.

[225] Walter Herriott, CEO St Johns Innovation Centre. See also Presentation from Dr Alex Smeets Director St John's Innovation Centre Ltd. 25% the percentage of deals into the Cambridge Cluster in 2007 that involved at least one US investor.

[226] Annalee Saxenian *Regional Advantage.* See also Rob Koepp *Clusters of Creativity, Enduring Lessons on Innovation and Entrepreneurship from Silicon Valley and Europe's Silicon Fen.* John Wiley [2002]. She seems not to have understood the ethos of 'Small Cambridge': see: *The Cheshire Cat's Grin: Innovation, Regional Development, and the Cambridge Case*. Economy and Society Vol 18, No 4 [Winter 1989].

[227] Interview 1. The Californian cluster sprawled into production in the immediate area with design and innovation laboratories and workshops; the result was some environmental damage, and notoriously poor working conditions for many of the immigrant work force. See a direct comparison in Robert Koepp, *Clusters of Creativity.*

> [228] *The **Holford-Wright Report** [1950] (prepared by the newly-formed County Council Planning Department, the Borough Council and the University) took as its starting point to goal of keeping Cambridge's character as a University town of international importance.*

The next major shift in planning was the **Mott Report** [1967]. A subcommittee of Cambridge University Senate examined the relationship between the University and science-based industry. The

Whereas Silicon Valley firms attracted venture capital from early days, took patents and commercialised early, Cambridge has a collective memory of benevolent, un-business-like and idealist spin-outs[231], which finally dwindled under poor and ambivalent management and government micro-management[232]. It is also deep in the collective memory that the structure and significance of DNA were first elucidated in Cambridge, only for that University to watch the spoils of commercial development harvested elsewhere.

3.2.2 The Full Expanse of the Technopole: Cambridge is a Networked City[233]

> *The Cambridge Phenomenon Revisited*[234] indicates that most new enterprises tend to concentrate in the town centre, if Science Park and St Johns Innovation Centre (at the northern perimeter of the city) are included that is 'nearly all' do.
>
> *"Most firms here do not serve the local market, nor just the national one, but are global in outlook, and know that unless they exploit ideas that give them an edge in that global market place, their competitors will."*

The Technopole embraces not only the town and its Science, Business and Innovation Parks, but Parks well beyond the town[235]. The most interesting extensions are into the neighbouring villages, where many small innovative companies have found homes in studios and workshops above the proprietors' garages, adjacent to domestic glass cutters and other local SMEs, and behind surburban supermarkets.

---

report recommended ***careful relaxation*** of policies and in particular the establishment of a science park on the edge of Cambridge. As a result, Trinity College founded the country's first Science Park 1970.
The new development ***West Cambridge Centre for Entrepreneurship*** has received a grant of £8M from local entrepreneur and VC Hermann Hauser's Hauser-Raspe Foundation The site will house Cambridge's Enterprise Company, which orchestrates the commercialisation of University IP. Adjacent office and research space is also being built.
The Library House Report paints the regional picture. It lists 17 cities and 5 universities in the region. Totalling the population of these cities however gives ***less than two million people***. While Cambridge cannot compare to this alone the ***combination of the populations of Cambridge, Oxford, Reading and London*** dwarfs this figure. Geographically the four UK cities are also probably closer to one another than those in the Valley.'

229 The notorious A14, a dual carriageway bottleneck from Huntingdon forking to the coast road and into town just outside Cambridge.

230 The Library House report (infra) lists 17 cities and 5 universities in the region. Totalling the population of these cities however gives ***less than two million people***. While Cambridge cannot compare to this alone the ***combination of the populations of Cambridge, Oxford, Reading and London*** dwarfs this figure. Geographically the four UK cities are also probably closer to one another than those in the Valley.'

231 Koepp (*supra).*

232 Koepp, Ch 8.

233 Local VC Interview 35. Due to planning restrictions on commercial growth within the city boundaries, the city innovative firm structure is now distributed between city plus the villages.

234 Segal Quince and Wickstead (SQW), a follow-up publication to their 1985 *The Cambridge Phenomenon.*

235 For example Great Chesterford.

An outer penumbra of pharmaceutical giants lie a short rail journey's distance from the town. Glaxo-Smith-Kline has a large complex at Harlow[236], Merck is situated in Hoddesdon, Hertfordshire, and Roche at Welwyn Garden City. GSK has recently declared a positive policy of 'Open Innovation'.

The days of block-buster drugs (the 1980s mainly) seem to have passed. Review of the financial markets indicates that share prices have of late (1990s) been bolstered by corporate mergers. However, merger capability with attendant downsizing - which also shrinks R&D - is finite. Therefore Chesbrough's notion[237] of harvesting ideas from University spin-outs and high tech start-ups would appeal to the large pharma corporates[238].

Eric Wilkinson of Cambridge Consultants[239] casts doubt on the long term future of OI[240]. His first concern is the reluctance of big corporations to sign non-disclosure agreements with smaller companies before talking to them.

Secondly, and importantly, he believes that unless big companies approach the discovery of deeply innovative ideas with an understanding that they must be mined for and subsequently deeply processed – in short worked hard - what they will harvest are shallow, feebly innovative ideas, or old ideas.

This ethos within CCL's culture was led by Lucy Roebottom, a chief consultant, who devised the Structured Idea Management (SIM) methodology discussed below. CCL regularly spends **50-200 man days** with clients to unearth highly innovative ideas.

3.3 The Great Cambridge Patent Controversy

3.3.1 Funding in Universities

> Until 2005, when the University Council Ordinance on Intellectual Property was revised, Cambridge inventors were at liberty to hold the entirety of their own IP. Years earlier a fierce debate on this policy began. In 2002 Professor Richard Evans[241] wrote:

[236] Invited for a day in September 2009 to discuss new Open Innovation Initiative.
[237] Open Innovation –hereinafter OI.
[238] Biotech investors assert that OI is not new, and has always been a method by which big Pharma recruited innovations.
[239] Hereinafter, CCL.
[240] *Has Open Innovation Already Run its Course?* Interface, CCL house journal, [Spring 2008].
[241] Professor of Modern History at Cambridge, arguing that a victorious assault on patent rights might well lead on to copyright sequestration. Prof Evans noted that academic salaries had dropped by 40% compared to the national average, therefore scholars valued their extra-mural production as augmenting income.

> Even under the present system, Cambridge says it makes £1 million a year from IPR …. It is not surprising it wants more - and where Cambridge leads, others will follow. This *will reduce pressure on the government to boost University funding*, so the Patent Office is busy advising universities to increase their stake in IPRs[242]. In this section we describe both sides of this far-reaching argument.

The Sunday Times reported in 2005:

> The university is concerned that the current system penalises junior staff who contribute to research but sometimes miss out while distinguished heads of departments can make millions of pounds[243].

It illustrates the argument with one of the largest deals known at that time, in which IP2IPO, an AIM-listed investment vehicle, gave £20m to Oxford University in return *for a stake in any companies that were spun out of its chemistry department over the following 15 years* [2001]. The rationale put forward by IP2IPO was that the research was conducted in publicly owned premises using equipment bought by public money, and that the tax-payer had a right to see some return[244].

Inventions provide what is known as *third stream* income for Universities, which the the Lambert Review[245] refers to realistically as 'small'[246]. It expresses concern that innovations should *benefit the economy as a whole* rather than to create significant new sources of revenue for the Universities. The Review rather blandly accepts the statement that:

> Most [US universities] acknowledge that their reason for engaging in technology transfer *is to serve the public good*[247].

However, the Review draws back from any equivalent to the US Bayh-Dole Act, which allows American Universities to control and exploit their own IP. Lambert urges early resolution of who owns what IP, since delays by uncertainty create bottlenecks in the technology transfer process:

[242] Times Higher Education Supplement, [1st Nov 2002].
[243] Richard Fletcher [27th Nov 2005], reporting in The Sunday Times.
[244] *Id.*
[245] Lambert Review of Business-University Collaboration [Dec 2003 – final].
[246] On average around 3%.
[247] Not born out by commentators such as Jennifer Washburn, see *University Inc.*

> One [barrier to_university IP commercialisation] is a lack of clarity over the ownership of IP in *research collaborations*. This makes negotiations longer and more expensive than otherwise would be the case, and it sometimes prevents deals from being completed.

This brings up the issue of non-disclosure agreements (NDAs), the complexities of background and foreground IP[248] and the complexities of collaborations in an increasingly global research landscape of diverse jurisdictions.

The formal structures introduced by the University to capture and clarify ownership of IP are discussed in the next section. The Boxed section describes the impact of the new IPR policy. Not least of the elements of debate was the anxiety over academics' ability to retain the Open Source ethos, and share software amongst themselves[249]. Ross Anderson, computer security specialist at the Cambridge Computer Labs attributed the proposed policy of 50-50 division of profits between the University and the creator to the advent of Microsoft in the town. The traditional practice was to issue software under a General Public License, the new dispensation would necessitate commercial licensing. Anderson believed that Microsoft, who have established a presence in the town, had plans to make its products standard use throughout the University, and that the University was overly compliant to his wishes. The Gates Foundation has certainly been generous with (£10s of millions) grants.

However, the new rules, clause 9 (infra) demonstrate that the academics have preserved their liberty in some measure.

[248] The former is brought to the table, the latter is developed after talks with the collaborator(s) start. Both must be legally clarified before work on a joint project begins in earnest.
[249] Computer Weekly [8th August 2002].

Council's Revised Ordinance [27 July 200], Intellectual Property Rights

The key clauses are 5 and 6

> **5.** Where intellectual property rights arise, or the right to apply for such rights arises, from the results of activities undertaken by University staff *in the course of their employment by the Universit*y, the *initial entitlement* to those rights shall be as provided in the following regulations.

First the document defines the bounds of the development circumstances:

> Research undertaken by University staff *in the course of their employment* by the University shall include *all research conducted under the obligation to do so, expressed or implied, in their terms of employment*. The time when, and the place where, particular research results are reached or achieved shall be factors to be taken into consideration in assessing whether the research is in the course of employment.

But takes account of, and exempts private consultancy:

> Where a person external to the University consults a University staff member for advice, that advice will normally be regarded as private and therefore as forming no part of her or his obligations in the course of employment by the University.

The crucial clause is 6:

> 6. The University shall have *the initial right to apply throughout the world for a patent for an invention, for another right in novel technology such as a utility model or petty patent, for a plant variety right or plant patent, and for a registered design for a product, any trade mark registration associated with another registerable right belonging to the University, or any other type of intellectual property that is dependent on registration, deposit, or grant at the time that these regulations are approved.* The University or its delegated nominee, currently the University's wholly owned subsidiary, Cambridge University Technical Services Ltd (CUTS), *will become the proprietor of any intellectual property right that is in consequence granted or registered*. A University staff member who is the relevant creator shall be named as such in the application.

Clause 9 attends to requests to release material under Open Source license:

> 9. Material or other subject matter *that is developed in the University of which the copyright is owned by the University, may be released under Open Source* or similar arrangements *on the authority of the Head of Department in which the material is created*. The Head of Department may delegate such authority within a Department without restriction. (When material is derived from material acquired under Open Source arrangements that require any distribution of derived material to be under the same arrangements, no authority to distribute need be sought.)

Allowances for students to keep their IP remain generous, the main exceptions being for sponsorships and collaborations where rights are owed to third parties.

The two departments with charge of capture and exploitation of Cambridge's IP are the *Research Services Department* (RSD) and *Cambridge Enterprise* (CE). Their roles are mapped on the following page. The relationships of the innovation creator to CE and RSD are constrained to minimise delays caused by any party, and there is a duty of frequent status update amongst the parties.

Where Cambridge Enterprise is involved in exploitation of IPRs, the share of revenues from net royalties shall be as follows:

Net Income	**Inventors (jointly)**	**Department**	**Cambridge Enterprise**
First £100,000	90%	5%	5%
Next £100,000	60%	20%	20%
Above £200,000	34%	33%	33%

Where Cambridge Enterprise is not involved in exploitation, the share of revenues from net royalties shall be as follows:

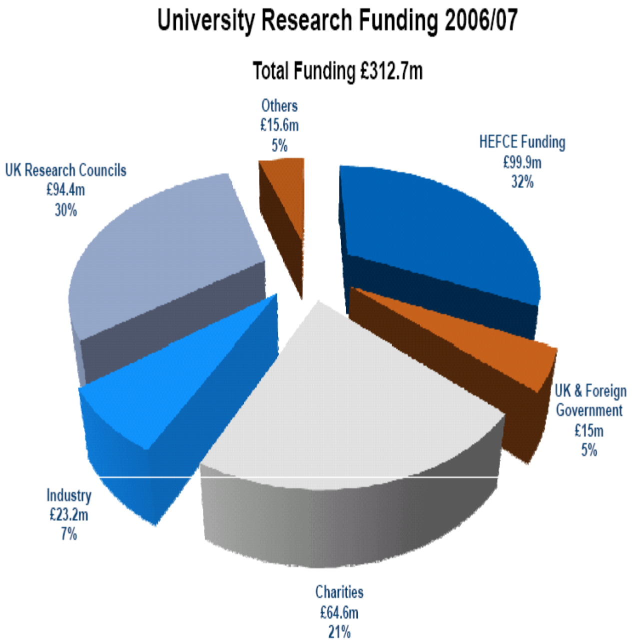
Net Income	**Inventors (jointly)**	**Department**	**Central Funds**
First £50,000	100%	0%	0%
Above £50,000	85%	7.5%	7.5%

Conclusion on the Patent Debate

The key to research in Cambridge is investment, and the key to investment is Intellectual Property. In the sections that follow it becomes clear that prizes reliably stimulate early thinking about innovations, but subsequent serious funding it acquired in exchange for IPRs. As one VC put it: 'IPRs are all there is'.

3.4 Cambridge's Formal Structures to Support IP Capture

3.4.1 Formal Structure to Intensify IP Capture[250]



To left is the funding cake that is available for University Research.

In Cambridge, the established *University Research Services Department* (RSD) is now augmented by *Cambridge Enterprise* (CE). The diagram on the next page shows the distribution of roles across these two entities. Each is designed to capture a part of the cake and co-ordinate their activities.

Cambridge Enterprise, initially formed in Dec 2006 as a wholly owned subsidiary of Cambridge University was made a limited company is 2008. Their report for 2007-8 gives the following facts:

During the period 1995 to year ending 31 July 2007[251]:

- ***University funds*** have made ***46 investments***, of which 43 were in new technology companies and 3 were in other early stage technology funds
- ***Portfolio companies*** have raised ***£390 million*** in follow-on funding**, plus *£12 million*** in grant awards, **a leverage of 45 times** the University investment.
- **18** of the **43** companies have made product sales – indicating a transfer of technology from the University to public or business use
- Portfolio companies collectively ***employ around 1,700 people***

This investment activity is now consolidated into Cambridge Enterprise Seed Funds, which manages two investment pools, with a third projected for 2009. This third fund is an 800-year celebration initiative to set up a philanthropic opportunity for alumni and friends to contribute to an *evergreen fund.* It will provide a critical resource for

[250] Relying on interviews 15, 18, 45 and the annual reports of the organisations.
[251] Note that University funds and portfolio funds refer to The University Venture Fund and Challenge Fund Trading Company Limited only and not the investment of technology transfer intellectual property for equity.

proof of concept, *pre-license, pre-seed* and *seed,* very early stage investment, enabling the transfer of University-related technologies for 'the benefit of society'. It is renewable in the sense that realisations will be returned to the fund to support future innovations. Donors and others can track the progress of sponsored projects in a wholly transparent fashion.

More recently Cambridge Enterprise has firmed up its consultancy wing, liaising with outside clients to supply expert witnesses and specialist advisors from the departments.

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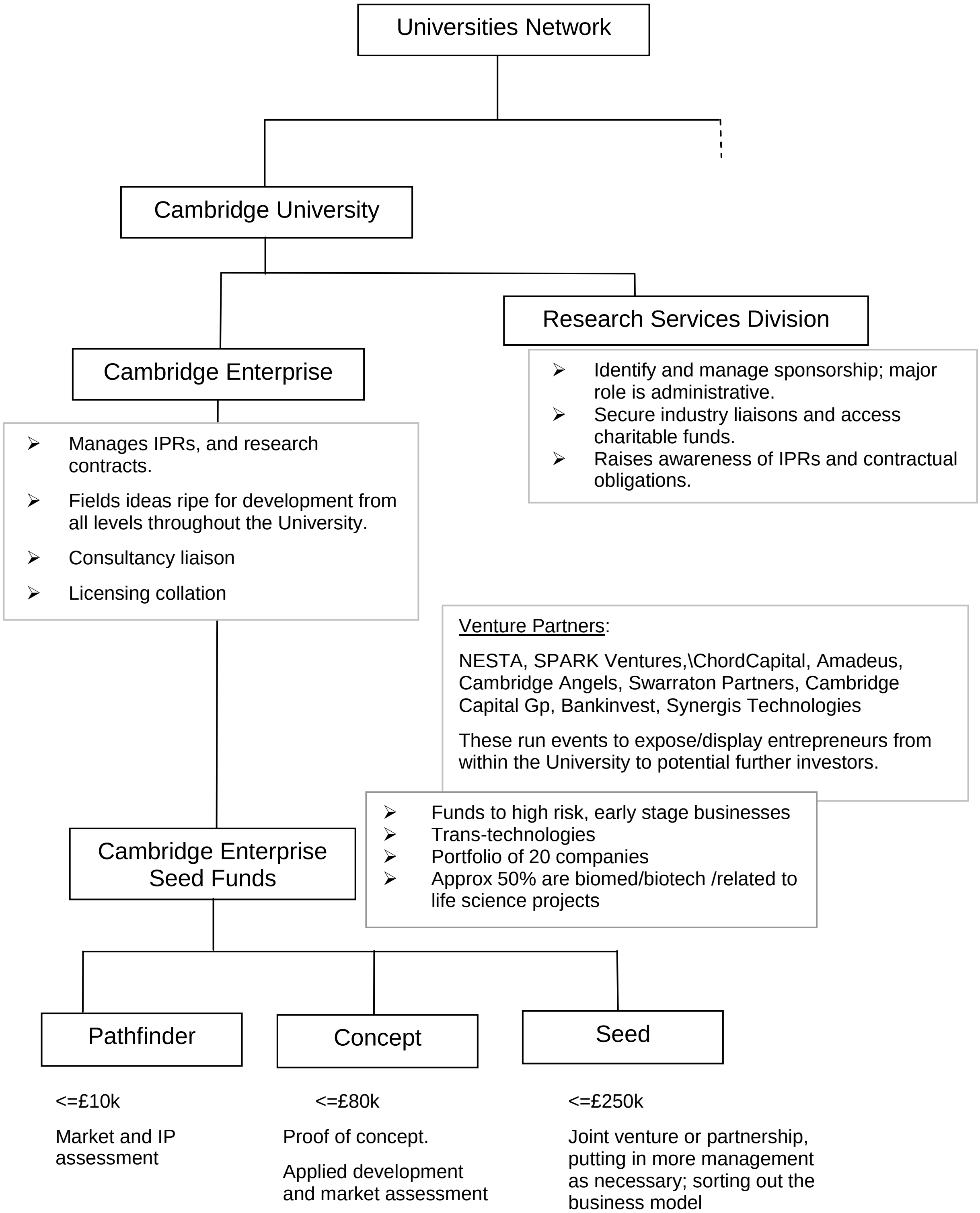
3.4.2 Profile of RSD and Cambridge Enterprise Functions



JS

In this dispensation ***start-up companies*** are considered those whose founders have been skilled within the University, but have developed there own IPRs even if within the University. ***Spin-out companies***, on the other hand, are companies developing IPRs that are University-owned.

It is worth noting that the Lambert Review discourages over-reliance of Universities on their spin-out companies, and would like to see the focus shift to licensing innovations for others to develop.

Along with its 2006-07 report, Cambridge Enterprise issued a list of Licensing Opportunities' responding to Lambert's urging towards licensing in rather than starting companies. Their offering includes 30 Life Science products including a drug delivery methodology, human monoclonal antibodies, and an endometriosis mouse model. They offer 15 physical science innovations including a Teflon derivative, examples of nanotechnology and a DNA sensor. There were three software copyrights available, including one bioinformatics software program and an intensive care monitoring system. In addition a range of monoclonal antibody reagents are also listed.

3.5 Local Investment in IP; Yet More Companies: Early Diffusability

> 'There is a willingness to create new initiatives 'bottom up', to give them a chance to be successful but also allow them to die if they are not – This ***may seem inefficient but it inspires creativity and entrepreneurship***, and promotes a culture where success is recognised and failure is forgiven'
>
> Tim Minshall IfM [2006][252]

3.5.1 Local Investment in the Cambridge Technopole

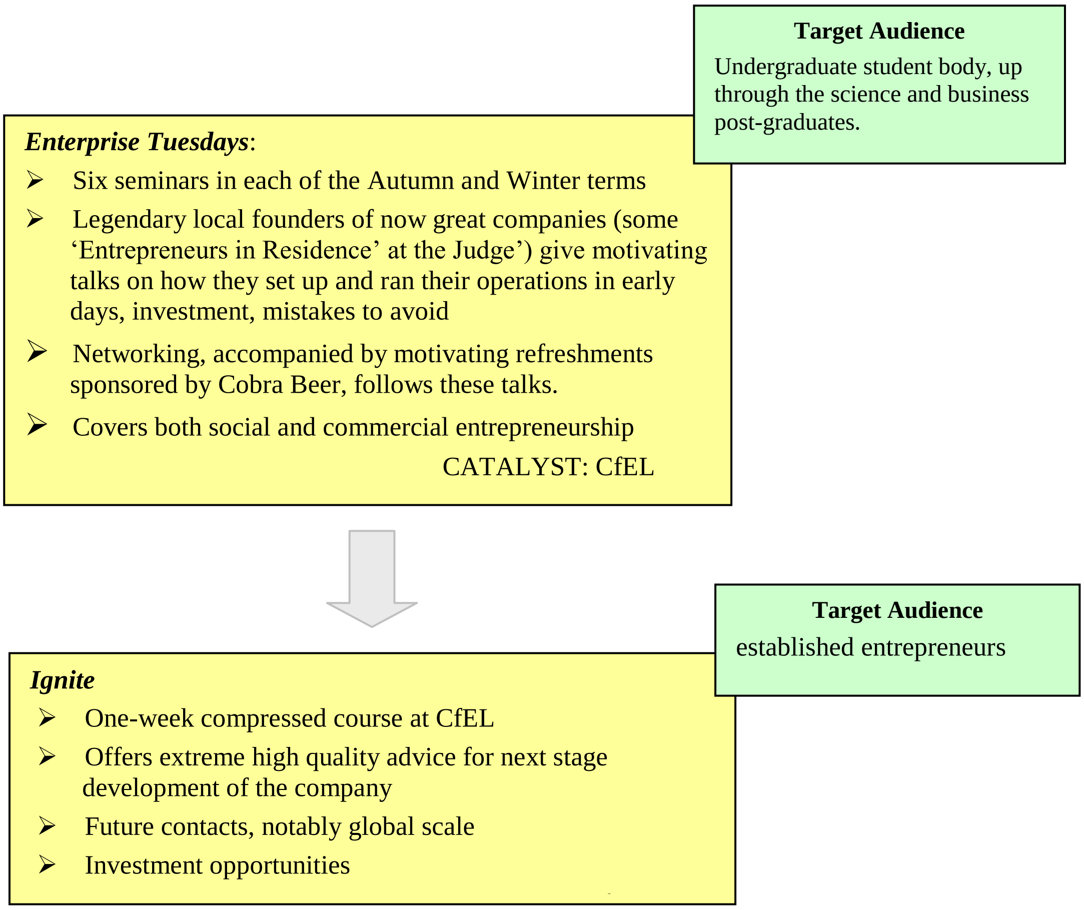
> 80-90% of start-up companies fail. The canniest investment houses cannot guarantee success in more than 50% of the companies they back. The investors' world view assesses companies against these criteria, and in this order: the *scalability* of the idea to a large enough market, the *brilliance of the team* that develops the idea, lastly the *quality of the idea*[253]. As regards the intellectual property the firm holds: some say this needs to be about tenfold better than that of the competitors.

Having reviewed Cambridge Enterprise's achievements, and spoken to its representatives, it may be concluded that it broadly favours:

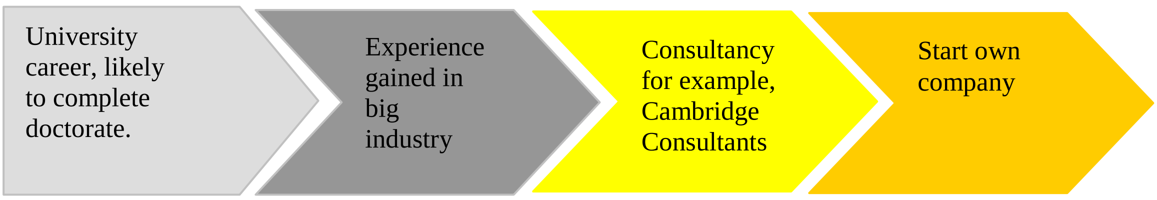
> Cambridge doing what it does best, educating to produce first class skilled people[254]. Tim Minshall IfM [2006][255]

[252] Presentation at St Johns Innovation Centre.
[253] Interview 17, representative of the company of a successful entrepreneur-cum-investor.
[254] Interview 45, a representative of Cambridge Enterprise.
[255] Presentation at St Johns Innovation Centre.

Cambridge seems always ready to spin-out companies and cherish independent start-ups. Much of this initiative is driven by the flowering of a close relationship between the *Institute for Manufacturing* (IfM, part of the thriving Engineering Dept), and the *Centre for Entrepreneurial Learning* (CfEL) at the Judge Business School. Their activities provide enduring, reliable support for start-ups and spin-outs. Regular briefings are issued by IfM's co-ordinator on the fine detail of setting up a business; and CfEL runs a stream of events for University entrepreneurs at all stages of their development (See diagram). Unilever is partnering IfM on a project to study Open Innovation; CfEL is joining IfM in the study.



The illustrated preferred path for many nascent science and engineering entrepreneurs is commended by one investor[256]:



[256] Interview 19

3.5.2 Departmental and Other Acceleration of Entrepreneurship

IfM is embedded in the **Engineering Department,**

Engineering moves to the West Cambridge development now being built

Expertise includes economists, business academics as well as engineers

Institute for Manufacturing (IfM)

CfEL is embedded in the **Judge Business School,** one of the departments in the University of Cambridge's School of Technology

- CfEL launched on 1st September 2003
- Not-for-profit
- Entrepreneurs in residence and visiting Entrepreneurs
- Originally part of the **Cambridge Entrepreneurship Centre** (est. 1999), which divided

Cambridge Enterprise

Centre for Entrepreneurial Learning (CfEL)

Shared activities are:

- Papers
- Training materials
- Event organizing
- Major research projects

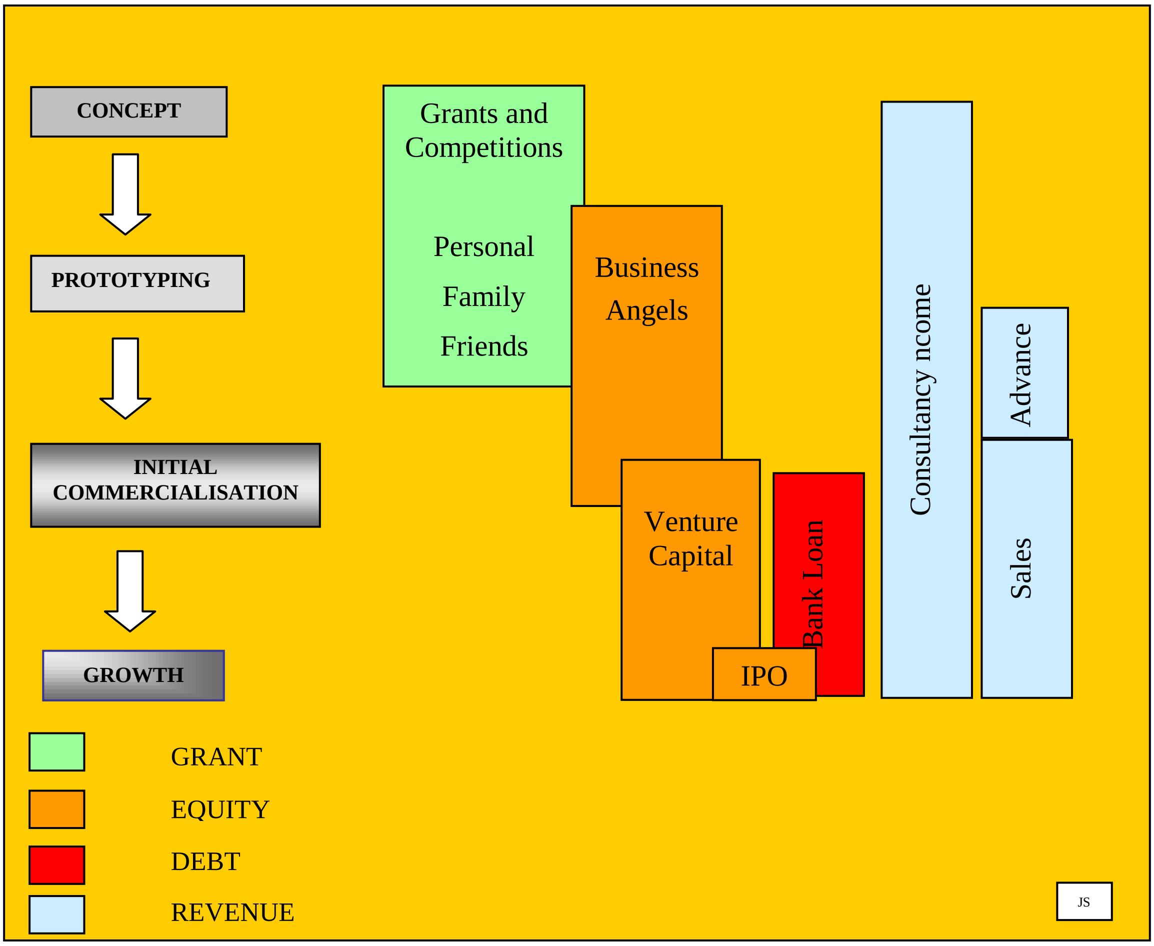
Co-operating with Unilever in a study of Open Innovation

The Cambridge-MIT Institute (CMI)

- First operational summer of 2000; goal to benefit of the UK economy.
- Financed largely by the UK Government with some £65m of grant funding, support for 5 years.
- **Value of MIT:** reputation as a hub of entrepreneurial activity; **Value of Cambridge**: hard science rigour.
- CMI off to a poor start, put down to initial ill-defined objectives?
- Current status: admits contribution of such collaborations can make to the economy is likely to be modest. Currently mooting knowledge integration communities of graduates, academics, other universities, companies, suppliers and government agencies. Target of collaboration to work *from idea conception* on specific knowledge transfer projects.
- Examples: attempt to design a silent aircraft, research into pervasive computing and nanotechnology.

3.5.3 Sources of Funding

The diagram below indicates appropriate generic funding for the levels of company development



Companies can sell their technology straight away, getting a one-off payment, license it, either exclusively or non-exclusively, sub-contract parts of the business (marketing, sales, support). The concept of '*open entrepreneurship'* is encouraged in light of the 2008-09 downturn to defray costs[257]. Alternatively they can manage the entire value-generating process in-house. This latter course has become rarer during the 2000s, as early stage funding grows inexorably scarcer[258].

Definitions of the Funding Types

A **Business Angel** is a wealthy individual who invests *her own* capital for a new company, usually in exchange for a share (equity) in the company. (Term due to, William Wetzel, University of New Hampshire and founder of its Center for Venture Research studied acquisition of seed funding, [1978] Wikipedia).

Angels can form groups and networks funding by consortium or according to their specialism. Angels overlap with Venture Capitalists in the Technopole. In Cambridge, Angels include the leading '***Cambridge Angels'****,* rumoured to require 8 references about any firm before the firm is interviewed; the informal ***Choir of Angels****;* the ***Great Eastern Forum*** (GEIF): very well-connected, with the local chairman having his own investment house. The angel looks to close on her return after 5 to 7 years.

Venture Capitalists *manage* pooled funding from other sources. Two key investors in the Technopole are: ***Cambridge Gateway Fund***, reckoned most active investor in the cluster since 2006, and ***Amadeus Capital Partners***, top investor in the cluster measured by syndicated amount invested since 2006.

NW Brown, Cambridge Capital Group and Cambridge Angels regularly provide seed funding. (Library House Report November [2007]). Cambridge Gateway Fund has now been acquired by Avlar Bioventures.

VCs obtain the funds, then *sieve* investment opportunities on well-tried criteria. In order of priority these are: (1) *scalability* of the project to a sizeable enough market, (2) quality of the management team, (3) quality of the innovation, (Interview 17). If this seems an odd order of importance, recall the remark of Herman Hauser, founder of Amadeus, that "an A team with a B product is a better investment than a B team with an A product".

Investors' appoint *Scientific Advisory Boards* to assess new or specialist technologies. In Cambridge the density of scientific specialisms and the plethora of network connections (national and global), accelerate the consultation process. Also a proven trust chain through the dense social network of local entrepreneurial academics-cum–investors renders confidentiality achievable; due diligence delays are reduced by the quality of the information.

Glossary

Initial Public Offering (IPO): shares offered to the public

Merger or Acquisition: company sold for either cash or shares in another company

[257] Term coined by Shai Vyakarnam at one of the Enterprise Evenings I attended.
[258] Interviews 15 with CE, and 19, with biomed investor.

The following figure indicates the stages in idea development, the means of support, and the company activities appropriate to each stage of funding. (Information obtained from *The Chilli* investment web site[259]).

According to Library House 2007, some 108 companies in the Cambridge cluster are venture-backed, totalling £600m of institutional capital, making it second only to London, and fourth in Europe .

[259] IfM briefing, Vol 1 No 1, and see *www.chilli.com* *The Chilli* is an online group that advertises itself as a 'unique media platform for high-tech entrepreneurs, investors and advisors'.

S1 (seed stage 1)	Company or an individual has developed *a concept*, carried out preliminary market research, now needs S1 funding to develop an effective business plan, and register the company.
S2 (seed stage 2)	Company has researched and developed initial business plan, needs S2 funding to create a model or a demonstrator (but not a working prototype yet). Needs to validate the business plan with detailed financial analysis, identify the founding team (but not recruit yet), and research and prepare (but not file) key patents.
S3 (seed stage 3)	Company has validated its business plan, product or service strategy, has some prospective customers who have seen the model. It needs to make a functional prototype, pay salaries to more people, and is engaging with corporate finance and legal advisors pre-VC approaches.
Round 1 Series A	Company successfully demonstrated its prototype to potential customers, partners, and will issue series A *preferred convertible shares* in as equity to access funding to fully develop the product or service, The R1 funding is for facilitating the agreed R1 milestones such as signed number of pilot customers, partners, number of staff and patents. Nominal revenue from its pilot activities got in.
Round 2 Series B	Company has its first pilot customers. R2 needed to satisfy more potential customers of *enough capital* on hand to fulfill contracts. R2 is for expanding sales, marketing, customer support, and internal functional areas. Also expanding its markets. Broadly must reach a break- even position and achieve a critical mass of customers.
Round 3	Company needs to consolidate its resources and market presence. to make a acquisition OR seek merger with a bigger organisation OR position itself for a successful exit via trade sale or initial public offering (IPO) via listing on a recognised share exchange such as the LSE or NASDAQ.

After incorporation, a company receives a few rounds of VC funding to help it grow rapidly, then once it has reached a certain size, or market conditions are favourable, the company either exits by an IPO or a trade sale. Unfortunately the model of three or four rounds of funding followed by company exit no longer works for most of the firms in the biomedical sector. There is no longer money to be made on exit as the pharmaceutical giants are not buying with the alacrity of former days[260].

Worse, early stage funding is becoming scarcer. One high tech investor reports that major local early-stage backers of the 1990s have moved towards buy-outs of more advanced stage companies.

Local VCs harvest funds from banks, both UK and overseas, Local Authority pension funds, the University, and even foreign sovereign funds (overseas government money). VCs lend to early stage companies on the basis of a transfer of equity[261], and expect the investment period to be around five years, followed by 5 years of steady return on capital. VCs may form consortia to lend.

Interviewee 19 reports that VCs in the European biotech sector ‘have not made money’ for the last nine years. He summarises the history of innovative biotechnology in Cambridge in this way:

> Initially they were ignored by Big Pharma, next they were cherry-picked. The early 2000s saw a merger phase; that has now stopped. Currently the Pharma giants outsource R&D.

Interviewee 49, a patent agent, reports a similar sequence across the last 30 years in the Pharmaceutical industry. The 1980s were a period of blockbuster drugs, raising share values. The 1990s saw mergers and down-sizing, presumably to maintain share value. The current strategy is to focus on what has come to be known as Open Innovation[262], as evidenced by the launch of the Eco-Patent Commons in January 2008[263]. Nine companies across industrial sectors have pledged to release around 100 ‘eco-friendly’ patents[264].

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[260] Interview 15 [June 2008].

[261] A commonly quoted figure is 33%. At each round a VC may ask for a further 33% of the residual! A company must gauge how many rounds it can afford and still remain in control of the company, and bargain hard. An important bargaining counter is good intellectual property.

[262] The Chesbrough model relies on two important statements: (1) knowledge lies dormant both within and outside the firm. (2) not all the smart people work for us, which is carte blanche to absorb University ideas output.

[263] Eli Lilly’s recent statement of opening patents.

[264] Bosch, DuPont, IBM, Nokia, Pitney Bowes, Ricoh, Sony, Taisei and Xerox. Report summer 2009, WIPO website.

Whichever the current model for R&D, intellectual property is the critical bargaining power. Although the biotech companies are major users of IPRs, it appears that this sector takes relatively fewer patents than, for example, software or wireless, see the filings and grants of patent for Cambridge drug delivery company Astex:

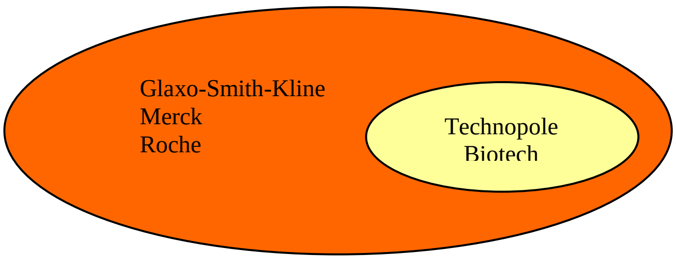
Year	**Filings**
2000	2
2001	5
2002	24
Year	**Grants**
2008/09	2, 4

In 2006 Autonomy Corporation, founded by Cambridge mathematician and software engineer Michael Lynch held 110 patents worldwide, with 50 pending, for a range of software inventions. Both Astex and Autonomy are less than a decade old.

Interviewee 19 assures us that, contrary to the much publicised sharing of skills and ideas in the computing sector in Silicon Valley[265], 'you won't find sharing in biotech' in UK. He also asserts that the 'market culture is different' in the United States, where the home market is huge, compared to European countries. He further suggests that 'something very ugly is happening in investment today':

> Suppose an established company needs an investment of £1M. The investor may make the investment but also demands a fivefold preference, which means in effect, that on sale of the company the investor's return is the first £5M.

Beyond the Cambridge Technopole lies a penumbra of major pharma companies. These might (a) employ scientists from Cambridge, (b) avail themselves of Cambridge ideas by some model of Open Innovation. The current trend is to outsource R&D; Cambridge Research Services brokers partnerships to this end between members of the University and outside firms.

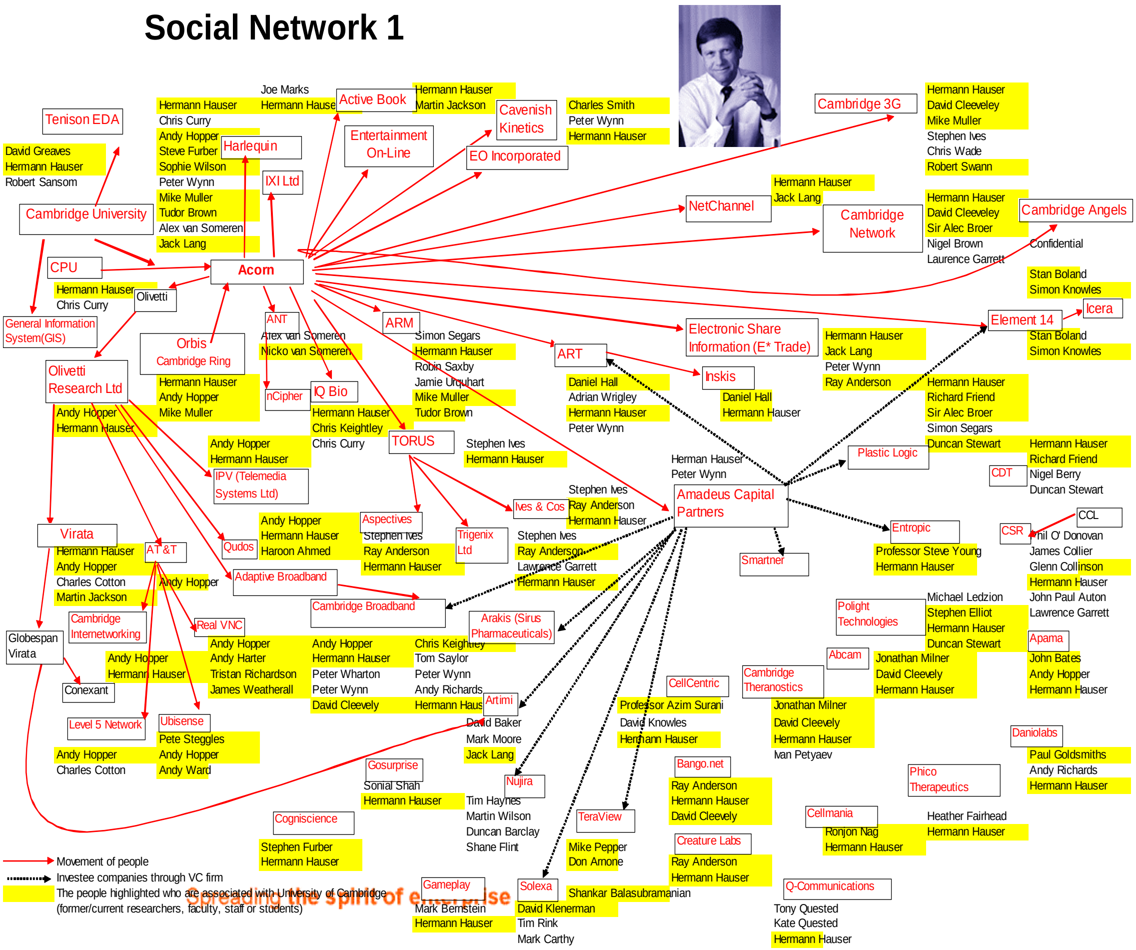


[265] Saxenian *Regional Advantage.*

3.6 Harvesting Existing Social Capital

3.6.1 Social Networks in Cambridge

The famous diagram below centres on Hermann Hauser, frequently called the Father of the Cambridge Phenomenon. It shows the companies in boxes, and their co-founders alongside[266]. Hauser founded Acorn Computers in the 1960s. Acorn flourished by capturing the contract to manufacture the BBC Micro [1981]. The firm subsequently foundered due to management problems, and was acquired by Olivetti. Its young team (twelve founders) went on to create ARM[267] in 1990.



266 All social capital diagrams presented for the Technopole are used with the kind permission of Vyakarnam and Myint. Details at http://www.transitions.co.uk/uploads/sustaining_the_spirit.ppt

267 Advanced RISC Machines

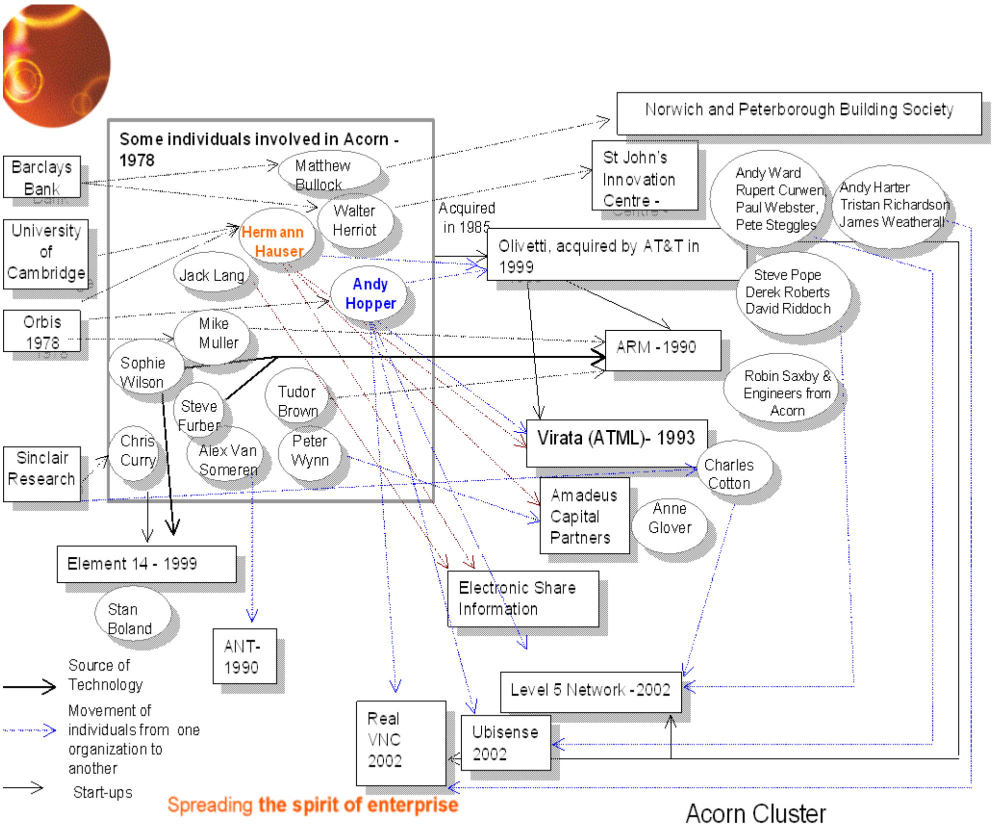
ARM's *Reduced Instruction Set Computing (RISC) processor* was initially developed by Acorn in 1985; ARM was spun out of a collaboration between Acorn and Apple in 1990, with the goal of creating a new microprocessor standard. There followed the development of an embeddable RISC core providing the first low-cost RISC architecture. (See diagram below).

The *global standard* ambition could best be achieved by adopting the concept of customer-partnerships, the earliest one being with Texas Instruments in 1993. As partners were progressively struck down by the obsolescence of their products, ARM intensified the strategy of multiple (and unrestricted) partnerships, all partners using their chip as a foundational building block for a wide range of products. ARM currently advertises itself as '*a purely intellectual property licensing company'*, and is ranked by Dataquest as the number one semiconductor IP supplier in the world. When ARM floated in 1998, the valuation was £264m; in 2005 it was £1.7b. The ARM strategic lesson rippled out to newer semi-conductor firms such as Silicon Radio and TTP Com.

ARM's home is Cherry Hinton village, 2 miles north east of Cambridge on the Peterhouse Technology Park. It has also opened sales, administrative and support offices around the world, and design centres in Blackburn and Sheffield in the UK and one each in France, California and Texas. The company has recently been investigated as a potential instance of the biological metaphor of *imprinting* (of the old company, Acorn) upon its child (ARM)[268]. ARM certainly learned the precarious nature of being a dedicated, single customer supplier, and changed tack towards non-exclusive licensing.

Hermann Hauser currently leads a local investment house, Amadeus, and mentors new Cambridge companies. The foundation he set up with his wife has donated £8M to the new West Cambridge Centre for Innovation currently being developed, and to which the University's Engineering Dept will transfer. The diagram below shows the founders of his original firm Acorn and their career trajectories and subsequent connections across the Technopole:

[268] Garnsey *et al. Imprinting-Deprinting-Reimprinting: A Process Theory of Intergenerational Learning and Spin-off Entry*, [2007], Koepp also notes the lessons learned, P217, *Clusters of Creativity.*



The diagram gives a broad picture of the alumnus network that ramifies the city.

Within the central box, Walter Herriot, a banker, went on to become the Head of the St Johns Innovation Centre, which provides small units for start-ups. He has recently retired from that post but continues in consultancy within the Technopole. Jack Lang, a software engineer, is currently a Visiting Entrepreneur at the Judge Business School, where one of his roles is as mentor to start-up companies. What is striking is that all these people are ***still on the network.*** The spread of talent is inter-generational, and history of the Technopole is remembered without disconnects.

An interesting example of sustained social capital is when the founder of a local data logging design company died. Although his funeral was held in the far eastern reaches of rural East Anglia, a good number of fellow scientists and engineers from earlier Cambridge days, now in their 80s, attended[269].

[269] Interview 54.

Many early-day founders of Cambridge companies have appointments as Entrepreneurs in Residence, or Visiting Entrepreneurs at the Judge. As such, their experience is not lost to the community, and is directly available to the University's newest entrepreneurs in the form of consultation and advice, which is most liberally given.

Another clue to the cohesiveness of the cluster is the *multiple roles* amongst members, either *sequential,* in *parallel* or *both*. For example, post-graduate students are called on to assist with events, which begins their networking career. They may work in consultancies, gaining them regional or global contacts[270]. Many young entrepreneurs start companies with the assistance of the University seed funds and/or CUE prizes. If an entrepreneur succeeds and grows rich, it is likely he will remain in the Cambridge area and invest in the sector he knows best, which extends his network career.

Garnsey's group reports that although corporates open branches locally, these were *more likely to close* than larger indigenous Cambridge firms with their accumulated local competence[271]. In Cambridge as elsewhere, larger firms provide the bulk of jobs. However their report states:

> We found that ***most of the larger established high tech firms*** had early indigenous roots in Cambridge rather than being attracted from elsewhere. This points to ***the value of competencies accumulated locally***, persisting through changes of ownership in some cases[272].

Summary

A *small number of people* have been involved in the creation and development of a *relatively large proportion of knowledge-based businesses.* They stay involved in the cluster because there are interesting opportunities for personal development and the area offers a good quality of life for them and their families[273.]

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[270] PACEC is a local economics reporting house, SQL is an industrial cluster specialist. Both have written reports cited in this deliverable about the UK's East of England, and both take overseas commissions. Both hire Cambridge graduates, as does CCL.

[271] Garnsey and Heffernan [2005]

[272] Garnsey [2009] p6.

[273] Interview 47a, CCL.

3.6.2 Interlocking Directorships in the Cambridge High Tech Cluster

Myint, Vyakarnam and New[274] drew on the work of Rosa and Scott[275], which demonstrated that 'the most successful entrepreneurs tend to hold multiple directorships or ownership stakes[276]. There appears to be a link between habitual entrepreneurship and multiple directorships, using Neergard's concept of the alpha entrepreneur[277]

In two successive papers Myint *et al* plot interlocked directorships, charting the links between the individuals concerned in the whole high tech cluster, and also the biotech cluster on its own, since it has long been the dominant sector on Cambridge

The work ceases at this point made by the authors: they wanted to highlight the importance of *human* networks, both social and professional, that bind the Cambridge companies together in a close community. However the limitations of the method omit certain critical people in the Technopole network:

> the first [limitation] is that [the method] can only provide one viewpoint *at the firm level* as it tracks the linkages between ***units/companies*** within the cluster - each individual with multiple directorships was used as the link between his/her portfolio.
>
> The second limitation is that directorship analysis provides a means of *mapping their* ***<u>formal</u>*** *association by linking companies and individuals through common directors or founders.* Thus it provides ***only a picture of the current <u>formal</u> relationships*** (impersonal configuration of linkages between people and units) and ignores the "relational aspect" between people.

The authors point to the fact that vital members of the Technopole are omitted by the current charts: eg networking groups or industry committees, and key business support individuals such as Matthew Bullock, Walter Herriot, and Alan Barrell do not appear either.

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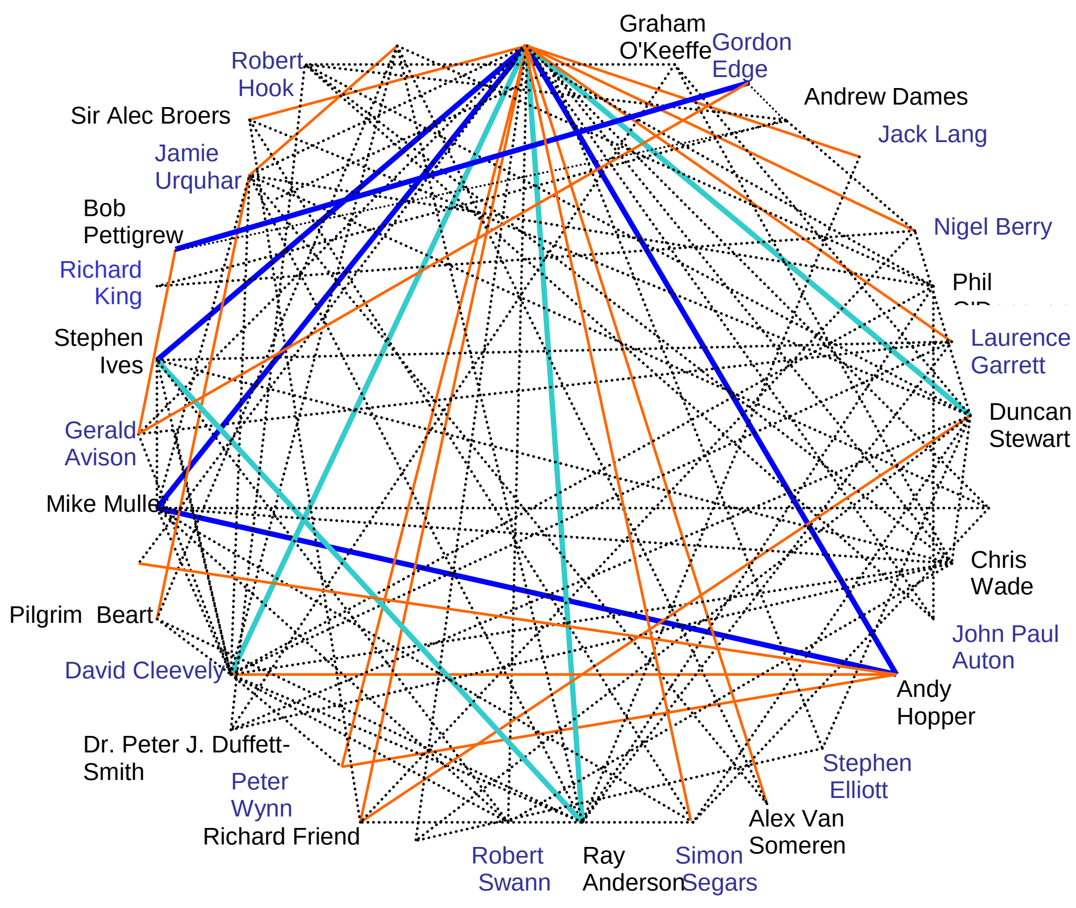
[274] *The Effect of Social Capital in New Venture Creation* CfEL working paper
[275] Rosa and Scott (1999) demonstrated that the most successful entrepreneurs tended to hold multiple directorships or ownership stakes.
[276] *The Prevalence of Multiple Owners and Directors in the SME Sector: Implications for our Understanding of Start-up and Growth,* Entrepreneurship and Regional Development 11, 21-37.
[277] Helle Neergaard, The Aarhus School of Business, Denmark: *Whose Network Is It? The Strategic Accumulation and Leveraging of Social Networks by Alpha Entrepreneurs,* Frontiers of Entrepreneurial Research, Wellesley MA, Babson College [2002].
Neergaard differentiated the <u>alpha entrepreneur</u> (or lead entrepreneur), from other members of the entrepreneurial team by his or her networking behaviour, and ***ability to build and use networks strategically*** in founding and growing a new venture.

The work confirms that in the *mini-clusters* of the Cambridge area, both in high technology generally and in biotechnology specifically, *there is are a limited number of entrepreneurs in the cluster*. Myint *et al* say this:

> The majority of high technology companies that have shaped the success of the Cambridge cluster are connected to *a handful of serial entrepreneurs, business angels and venture capitalists* as their involvement in developing new ventures has been repeatedly evidenced on the diagrams.

Their plots of structural social capital are shown here with their kind permission[278]; structural social capital describes the impersonal configuration of linkages between people and units while relational capital describes the personal relationships that people have developed through a history of interaction. The next diagram takes accounts for the entire high tech cluster.

Notation:	**Dark blue thick line: 4 links**	**Light blue thick line 3 links**
	Red line: 2 links	**Black dotted line: 1 link**



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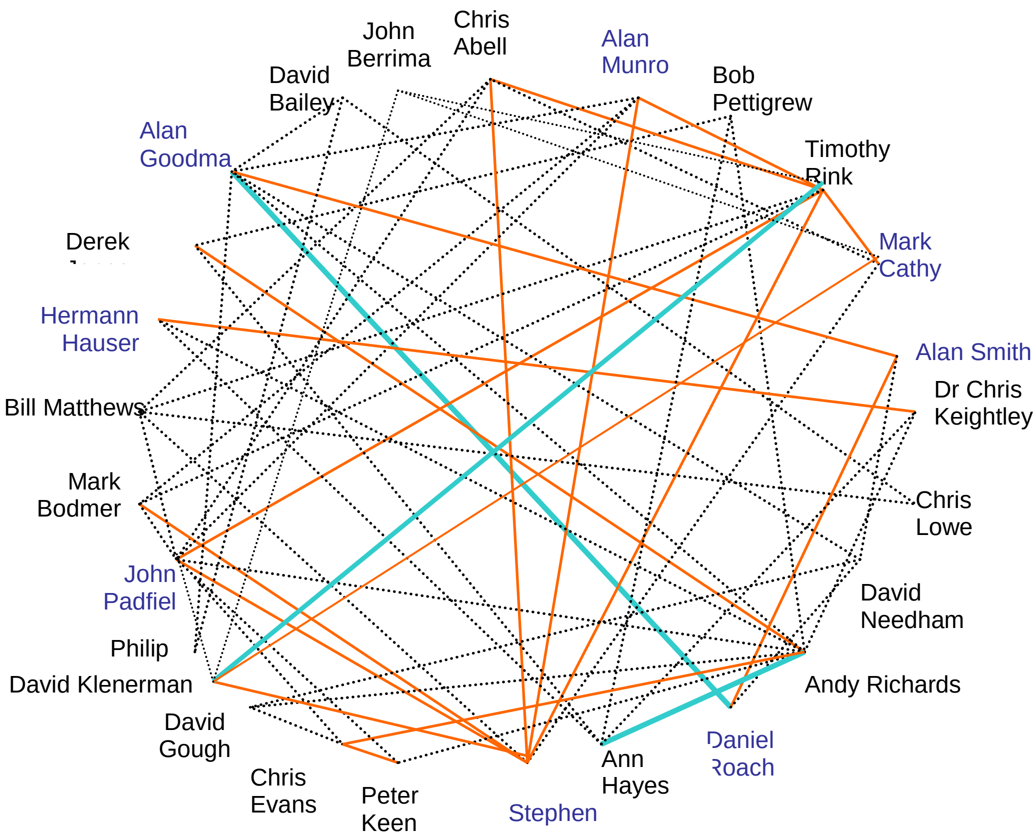
278 Pers comm., on file with author.

The following diagram shows Structural and Relational Social Capital purely for the Bio-Technology Cluster, the most significant sector of innovation in the Technopole.

Notation: Thick blue line: 3 links , red line: 2 links and black dotted line: 1 link.



3.7 Creating New Social Capital: CUTEC and CUE[279]

> ‘Some university departments are … developing networks with their graduates.
>
> Cambridge University’s computer laboratory has created a graduate association that focuses explicitly on developing a network of its computer science graduates. The graduate association not only provides the laboratory with funding but also gives the department access to a valuable network of graduates working in business’. Lambert Review

3.7.1 Emergent and Self-Organising Structures: CUTEC

Increasingly a pattern of early entrepreneurial activity is encouraged in Cambridge. Apprentice-piece projects enable students to essay and hone their skills in industry[280], and these support structures have become formalised over the past few years. The movement takes the form of partnerships between Cambridge University Departments, liaisons with other powerfully science-based Universities outside UK, partnerships between the departments and science-based corporates from outside, and a great deal of early student entrepreneurship, which in turn attracts outside commercial interests, formalized by international conferences[281].

The Cambridge University Technology Club (CUTEC), a year ago had a traditional structure of President, Treasurer and so forth. The current structure is highly distributed with an executive of 80 (see figure). Thus the work of running major events is distributed across many (busy) doctoral and Masters students from Science, Engineering and Business disciplines. The organisation benefits from links with MIT via the Cambridge-MIT Institute (CMI). One scheme adopted from the American partner is the I-Team scheme. At present CUTEC is undergoing further development of its structure[282]

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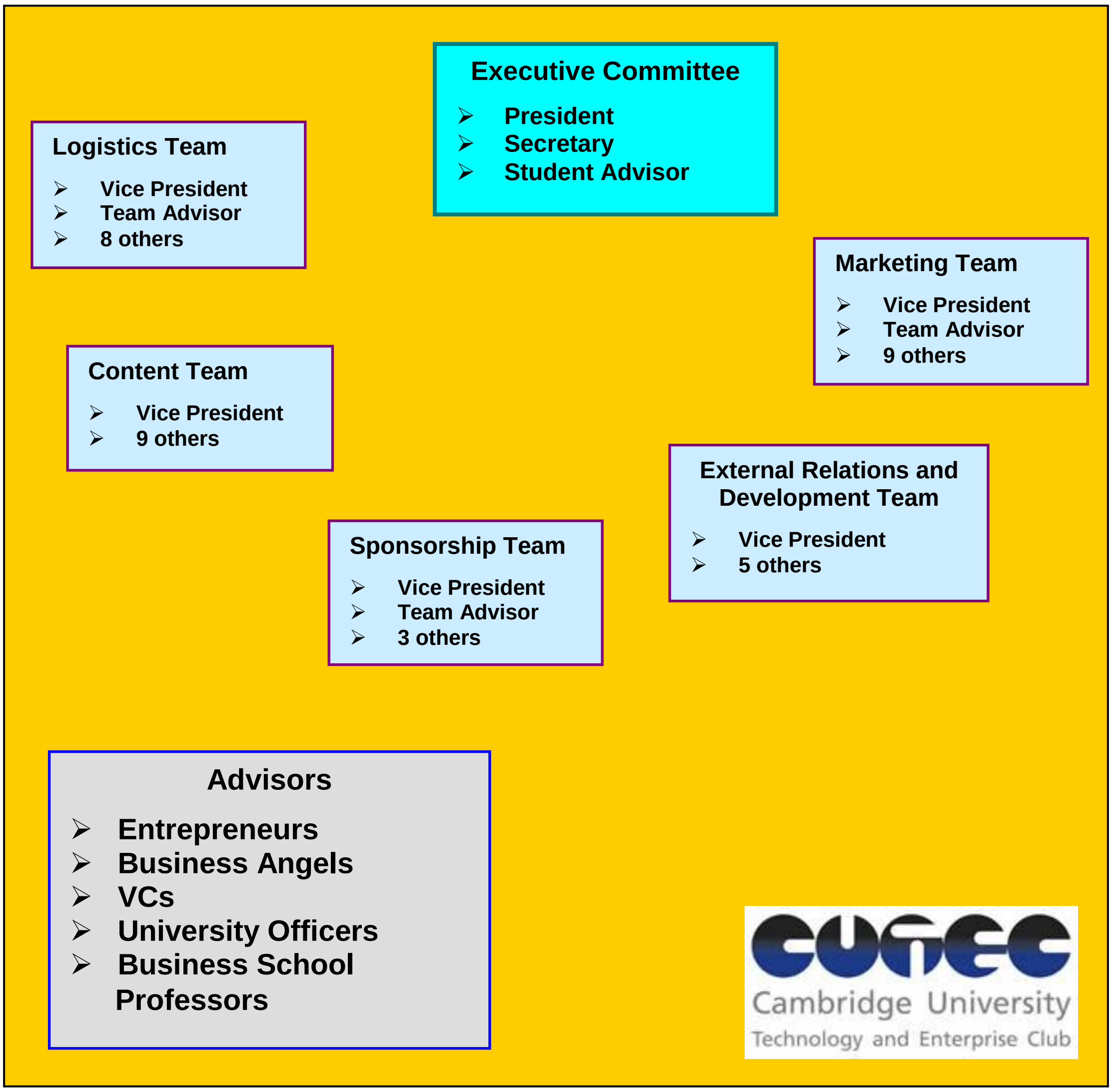
[279] Cambridge University Technology and Enterprise Club, founded 2003 by PhD students in science, engineering and business; Major sponsor the early company investment house DFJesprit, associated with the CfEL at the Judge, ‘championed’ by. Now has over 70 in a ‘*distributed’* executive team. With advisors such as Alan Barrel (biomed companies founder) Robin Saxby of ARM Holdings, Chris Abell of Astex Therapeutics), many specialist investment houses, CEOs of high tech companies, the Director of CfEL, and various legal and patent specialists.

[280] Report of Amy Mokady, I-Teams Program Director, at the 6th Annual Technology Ventures Conference, Cambridge [June 2009].

[281] Summer 2009’s CUTEC annual conference brought in a speaker from Google’s Search Team, to explain new directions and products.

[282] Interview with the President due.



CUTEC History

The declared aim of the Club is ***engagement of Venture Capital for technological innovations***. The club was formed in 2003, and held annual conferences from 2004 onwards in London until 2005, from then on in Cambridge. This year's conference was truly international; around 270 delegates attended. Of these about 40% were entrepreneurs or service professionals, another 40% were students.

CUTEC Communication Methods

The club uses its web site to advertise its events, and email for linking members and team to inquirer communication.

It uses YouNoodle[283] to link its student members with other entrepreneurs globally[284]. YouNoodle recently ranked Cambridge University third worldwide, after Stanford and MIT amongst entrepreneurial schools. CUTEC participates with the Centre for Entrepreneurial Learning (below) in delivering Enterprise Tuesday[285] talks and networking sessions (see ch2).

CUTEC has collaborated with CUE (Cambridge University Entrepreneurs) in an Investors Forum[286] where a particular focus was the advice for the current economic downturn. CUTEC is one of the main organizers of *Silicon Valley Comes to Cambridge,* an annual event[287].

3.7.2 Competitions and Prizes: Cambridge University Entrepreneurs (CUE)

CUE was founded 1999**.** Its prizes offer stratified incentives, which demand increasing levels of expertise and commitment from the entrants, so students can hone their entrepreneurial skills by degrees. *The Entrepreneurs' Challenge* for business creation took under a year to set up, and is run by students. The prizes range from £100.00, (20 awards); £1,000.00 (10 awards), with the pinnacle of achievement being the £5K challenge (6 awards). The streams or sectors are *technology, social enterprise* and *software*. These sectors reflect the interests of the entrepreneur and investor sponsors. The top sponsors are ARM and the Cambridge Business Angels. CUE measures its success by the value of the companies that 'were created through the competition' which it says are now valued collectively at over £42m.

[283] **YouNoodle** is a San Francisco-based company providing this dedicated networking program for mall businesses. It uses a mathematical model from Kirill Makharinsky, co-founder with Bob Goodson. Both were Oxford University students and now operate from California. Their web site operates as a *predictor of start-up likely success*. Tested on historic data it points to the under-estimates of success with Google and Face-book, among others, and reckons to do better. The service is free to start-ups, but charges third parties. As of August 2008, the algorithm was based on data from 3,000 startups. In the same month the company had four patents pending on the technology.

[284] I joined this network giving quite a narrow academic profile, and immediately received 10 links to others with those interests

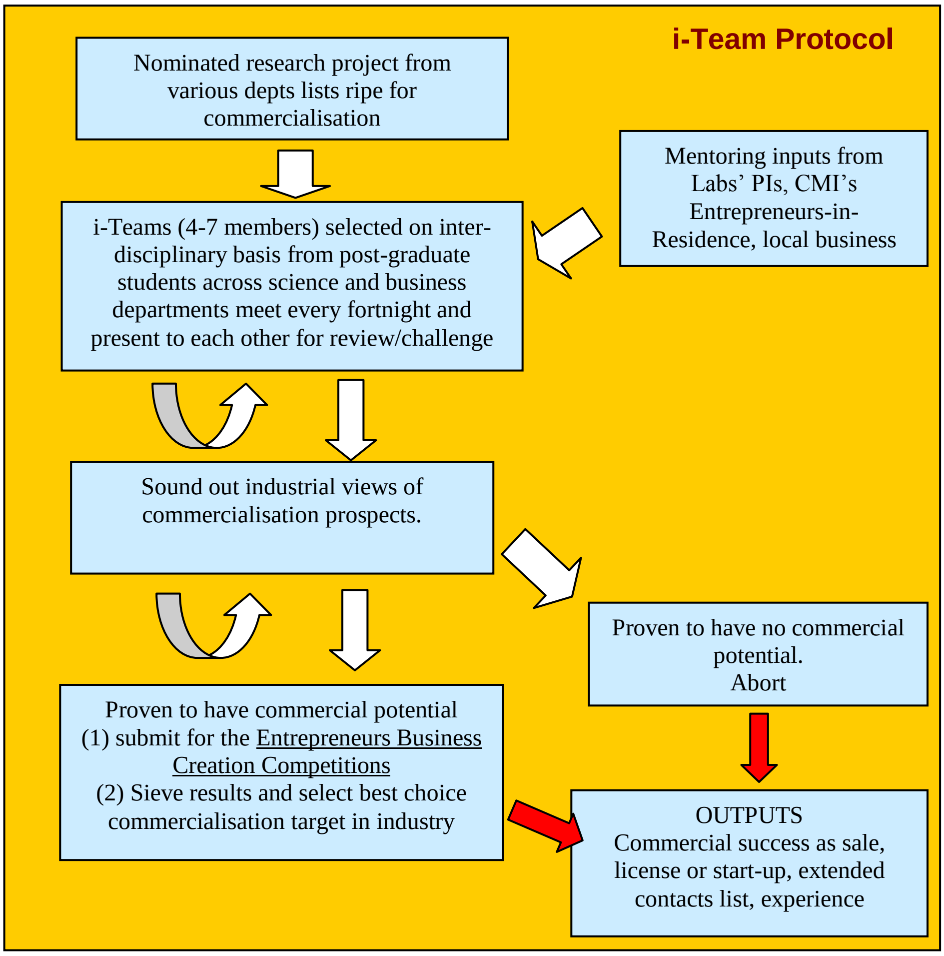
[285] Six seminars in the Judge Institute, called *Enterprise Tuesdays,* and a CUTEC event called *Let Us Show You the Money*, where investors provided guidelines. These events are designed for the undergraduate student body, up through the science and business Masters and Doctoral ranks to the start-ups and professorial spin-outs. All events enabled networking amongst these groups, the speakers, and other attendees. Several interviews in this study are based on events mentioned.

[286] 11th Feb 2009

[287] Interview 1 with one of the previous organisers of this event. This interviewee is a mature PhD student in the Engineering Dept, an erstwhile Boston and California Bay Area investment banker and entrepreneur.

CUTEC co-founded the i-Team project with the Cambridge-MIT Centre (operating as shown in the diagram below). The i-Team focus is grouping entrepreneurial graduates from business and science, and mid-wifing projects selected for commercialization to a marketable state. These can be entered for Cue Challenge prizes.

Key is the steering committee drawn from academics in IfEL and IfM, investors, entrepreneurs and Science Park leaders. CUE has prepared investment handbooks and offers patent advice, indicating the degree to which IPRs are embedded in the culture.



3.8 A Review of Incentive Schemes

This section looks at alternative to IPRs and their exchange for investment for stimulating innovation. The use of prize systems, its support and success are examined.

Governments have taken different views of whether publicly sponsored research should also be patentable. The U.S. government permits and even encourages patenting of results from government sponsored research; for example, the Boyer-Cohen patent. In contrast, *the British government forbade the Cambridge Molecular Biology Lab from patenting monoclonal antibodies in the mid-1970s.*

Permitting patents on government sponsored research rewards successful innovators twice, once through government funding and again through the patents[288].

3.8.1 Patent Justification Revisited

Some commentators[289] suggest that the justifications for patents are changing. Whereas traditionally patents were legitimised as incentives or rewards for creative and socially useful inventions, nowadays patents are primarily justified economically by regarding them as a device to capture the 'return on investment'; perhaps even as a 'credit' for further investments.

Edmund Kitch's "prospect theory" has influence; that and Julian Forman's *Timing Principle* point towards broad and early awarded patents.

Joseph Stiglitz commends prizes and state grants for innovation as most promising when they are a function of a social need or value. He says this:

> Patents are not the only way of stimulating innovation. a prize fund *for medical research* would be *one alternative*. Paid for by industrialized nations, it would provide large prizes for cures and vaccines for diseases such as AIDS and malaria that affect hundreds of millions of people. Me-too drugs that do no better than existing ones would get a small prize at best. the medicines could then be provided at cost.

However, Stigitz' remarks do not seem to imply any substitution of a prize system for patents; prizes do not seem to be 'a system' for any state. Marlynn Wei cites the mooted Medical Innovation Prize Act of 2005, H.R. 417, 109th Congr. [2005]:

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288 *Intellectual Property: When Is It the Best Incentive System?* Nancy Gallini, *University of Toronto* Suzanne Scotchmer, *University of California, Berkeley*.
289 Schneiderman.

> The purpose of this Act is to provide incentives to invest research and development of new medicines by establishment of a Medical Innovation Prize Fund[290].

Taking the definition of *deadweight loss* as including pure loss to society when consumers do not get a product that they value more than the cost of producing it, she cites Guell & Fischbaum's figures for deadweight loss of monopoly pricing of drugs to be between $3 -$30 billion for the US market alone[291]. Wei also admits that the prize system is best chosen in socially meritorious areas such as progress in medicine, but is most unlikely to disturb entrenched patent practices.

Modern prizes do exist but are they for invention or commercialization? A Timeline for major prizes indicates that they reflect especially means and aids for transport; scientific hotspots. Prizes across three centuries show a degree of serendipity in their selection of topics. The first to cross the Atlantic, or the Channel by airplane, other travel advances, mercantile instruments, and so forth. Fads and fashions rather than needs seem to have been the governing criteria of the awards.

The great merit of prizes seems to be that it removes the arena of contest from the market to the public purse; Wei describes its Achilles heel as its administration. In this she echoes the well-rehearsed arguments in our Ch1 literature review of Penrose and Machlup from 50 years ago. Wei also points to the imponderable of *incomplete information*, as between the government administering the prize and the competing companies. What is the cost of the invention as compared to the prize offered?

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[290] *Should Prizes Replace Patents?* BU J Sci and Tech Law, Vol 13.1 [2007].

[291] *Toward Allocative Efficiency in the Prescription Drug Industry*, 73 Milbank Q. 213, 226 [1995]. See also Michael Abramowicz, *Perfecting Patent Prizes*, 56 Vand. L. Rev. 115, 127-70 [2003].

Suzanne Scotchmer points to a rich inheritance of externalities and spillovers which provide the holistic picture of cumulative research across time and lead to today's useful patentable innovations. Her key point is that the *breadth* of a patent can inhibit the generation of valuable successors that fall within its scope. This she attributes in part to the US *Doctrine of Equivalents*[292]*.* She says this:

> Patent protection would be an unnecessary policy tool *if the government had the same information about the costs and benefits of individual research projects as firms have.* In that case, the government could simply select the research projects that would be socially efficient and commission research from the lowest cost firms[293].

James Love's Centre, *Knowledge Ecology International,* takes a similar line in many of the papers issued there. The views expressed are almost all focused on critical health areas[294].

3.9 Measures of Success of the Technopole

(a) **Prizes:**

Cambridge has earned 20% of all Nobel prizes in medicine and chemistry, and in chemistry, medicine, physics 69, (compared to Oxford's 27, here the focus is the humanities). The Academic Ranking of World Universities for Cambridge, jealously guarded was 2nd in [2005][295]. Cambridge is an investment hotspot[296].

(b) Patents

Cambridge patents boost the East of England figures given below

	Filed		**Granted**	
Region	**2003**	**2004**	**2003**	**2004**
South East	3,591	3,547	799	820
London	3,794	3,657	561	645
East of England	2,445	2,475	420	492[297]

[292] Equivalent innovations to the patent can also be claimed by the inventor, though she did not actually describe or make these.

[293] *Standing on the Shoulders of Giants: Cumulative search and the Patent Law* Suzanne Scotchmer Journal of Economic Perspectives- Volume 5, Number 1- Winter 1991,- 29-41.

[294] Interestingly, Ron Marchant, previously CEO of the UK IP Office seriously reviews the place of prizes, as does Tim Hubbard, of Cambridge's Sanger Centre for Genome Research, collaborating with James Love in joint publications.

[295] *The Cambridge Advantage* John Snyder, Entrepreneur in Residence at CfEL in the Judge Business School, Cambridge.

[296] 23% of UK venture capital and 8% of total European VC goes to firms in Cambridge (reported Snyder 2005).

[297] Reported *The Chilli* March [2006].

Conclusion

- The Technopole is becoming increasingly IPR/private investment driven. This is evidenced by the establishment of Cambridge Enterprise as a limited company, the relatively recent nascence of the Centre for Entrepreneurial Learning (CfEL), the collaborative structures set up between engineering and business departments, and the high profile of the local investors *as mentors.*
- The students themselves are increasingly prepared to establish and run entrepreneurial groupings, thereby intensifying and interweaving the local network structure on business-orientated terms.
- Critical is the geographical intimacy of the Cambridge institutions. An architectural academic, working across two locations for her department separated by only two streets, intimated that this physical separation was a profound barrier to a fertile exchange of ideas.
- I asked nearly every interviewee in the Technopole study what they considered the best network in Cambridge. Most said 'Cambridge itself'. One said 'DJ' (a mutual friend of ours and retiree who seems to know everyone). Yet this last response is more than a quip; the elders in the Technopole are, broadly speaking, the most densely connected (this is confirmed by the work of Myint *et al*). They remain active in the network, they are frequently given Emeritus posts and cherished for their experience.

  An important comment was that 'dining is important'. The colleges are subject-neutral. One college[298] has the tacit rule that whenever you come to the dining room, you must sit next to the last person at the table. This attitude and the consensus of my findings imply that collegiate scholars feel the omperative to map their interests to those of their neighbours as a matter of manners. This inevitably generates touchpoints between disciplines, and frequently becomes fertile ground for multidisciplinary projects.

Barriers and Opportunities for the Catalyst/Investigator in Cambridge

Although the local highly innovative firms are far too busy to act as SME drivers for the DE, the budding entrepreneurial groups are eager to listen to new ideas, and to this end, links have been made with CUTEC. Strong links have also been forged with CfEL, which lies at the heart of promotion of Cambridge's entrepreneurial life.

[298] Clare Hall.

CfEL is actively questing for partners, notably in the digital platform field, and it is recommended that OPAALS supports the Regional Catalyst in making approaches to CfEL on the DE project.

The DBE project aroused quite some interest in the Cambridge Computer Laboratories Open Source community[299]. Members of the Labs staunchly defended Open Source protection during the patent controversy, and would have been prospective allies for the DE project. However, the perception was that the DBE in later years developed a low profile, and did not generate implementations that could add anything to the deployed systems presently in use.

[299] Earlier work by Stanley for EEDA, and an interview with chief Linux operational expert at the Labs.

Chapter 4

Peterborough, Aspirations and Actualities

> Visit Peterborough cathedral and glance up at the ceiling of the Eastern Building. If this seems familiar to those who have visited King's College Chapel in Cambridge, it is because its prototype – the precursor to Kings - is built here, in a Cathedral town 30 miles away across the fens.
>
> From a national regeneration point of view, a happy thought is that this interchange of master masons might be succeeded 600 years later by a transfer of masterly research from Cambridge to supply commercial opportunities for Peterborough.

Part 1: Business Profile of the City

The chapter explores the *aspirations* of Peterborough to become the environmental industry capital of the UK, and the *actuality* of the rise in the city of more dominant industries, such as warehousing and distribution. These realities are reported by the economic and innovation surveys of the city from PACEC[300], SQW[301] and others, and gleaned from interviews collected in this study. The chapter deals with the structures put in place through government intervention to support the environmental sector, and their funding. It sharply distinguishes the Environmental Goods and Services sector (EGS), in which Peterborough is rich, from the Environmental Technology (ET) sector, (which implies research and development), in which Peterborough is relatively poor.

Two effects are striking. The first is the number of *anti-networking effects* uncovered in Peterborough's recent development (some not intentional, nonetheless counter-productive). These are expanded on with examples. The second is the proliferation of public and private (and hybridized) *'initiatives'*, many of which seem not to join up so as to complement one another to be productive of a thriving and innovative community.

All inquiries in this study sought to determine a route through to establish a European model DE in one or more contexts in the city.

[300] PACEC: Public and Corporate Economic Consultants, Cambridge.

[301] Segal, Quince and Wicksted, authors of *The Cambridge Phenomenon. Environmental Technologies and UK Productivity,* Final Report to Defra, [June 2007]. SQW was commissioned by Defra in November [2006] "*to identify, critically analyse and synthesise evidence on the potential contribution that environmental technologies can make to the UK economy as a whole*". Also SQW's *Framework for Urban Collaboration in the East of England,* [May 2007]. Cambridge's PACEC economists were commissioned to write Peterborough's *Sub-Regional Economic Strategy 2008-2031.* Submitted [June 2008]. The report contains the finding that warehousing is a particularly strong sector, and that there is very little high technology activity in the city. See also interview 12.

4.0 History Matters

In their NESTA report[302], of the same name as this section, Simmie *et al* pair towns and review how effective strategies to promote innovation in one town are not necessarily, if at all, transferable to another. They distil a number of characterising properties of 'leading' and 'lagging towns' from their examples. *Lagging towns* show a pattern of combining *few large private sector employers* and a *large public sector*. This they believe fails to 'foster a culture of enterprise'. Such towns lack local investment and have thin venture capital markets[303]. *Leading Cities,* on the other hand, show a tendency to have more people working in *knowledge-intensive occupations* (KIOs)[304]. Leaders show more employment in R&D and university research than other cities, which is reflected in their patent rate. The entrepreneurs have better aptitude in commercialising new ideas as a result of *higher levels of knowledge-intensive business services* (KIBS) in such towns. This section gives a small history of the Peterborough area.

From the middle of the twentieth century waves of immigrants came to work in the industries of Peterborough, then a smallish market town. Labour-intensive activities such as food processing, notably beet sugar refining, brick making, light and heavy industries (including rail equipment maintenance depots) flourished, each in turn, then declined. More recently the service sector, notably Finance and Local Government have expanded.

Portuguese, Italians (1950s mainly), Asians and most recently East Europeans (2004 onwards)[305] came to Peterborough to seek work. In addition, a substantial number of Londoners arrived as overspill in the wake of 1971 designation of Peterborough as a new town. From the 1990s on, yet more London workers arrived; the rail link to London is good, and housing is a great deal cheaper than in most parts of the region.

The city currently boasts a large warehouse and distribution sector. There is scope here for logistics research, for example deployment of further developments in RFID technology, which currently displays a high degree of sophistication[306]. However, the

302 James Simmie, Juliet Carpenter, Andrew Chadwick and Ron Martin (Oxford Brookes and Cambridge Universities), *History Matters* [July 2008]. This source is also cited in Ch 3 (The Cambridge Technopole) where Cambridge is paired with Swansea for historical parallels and influences.

303 Of the 6 important local high tech investors interviewed in the Cambridge study, none had any interests in or information about Peterborough.

304 Care is needed with this category of definition, as purely clerical jobs may be classified as 'knowledge-based' when in fact they represent skills far lower than those of many artisans.

305 Currently estimated as 16, 000 persons.

306 Interview 6, with logistics consultant to the Universal Postal Union (UPU), currently devising community RFID standards for the postal industry

major players becoming established in this sector in Peterborough (Debenhams, Gazeley[307]) are expected to use mature technologies developed elsewhere.

High-reputation advanced engineering firms such as Baker Perkins (diesel engine technology), and Peter Brotherhood (turbines), have been acquired by US corporates; the former by Caterpillar, the latter in 2008 by Dresser-Rand; in both cases shrinkage of jobs resulted.

£80 million of Government investment is now earmarked to upgrade the railway line between Felixstowe (main regional port) and Peterborough by widening tunnels and strengthening bridges[308]. This has triggered the warehousing giant Gazeley to draw up plans for an 'inland port' called Magna Park, to occupy 135 hectares of farmland at the south-eastern fringes of the city. However, the majority of the projected 5,400 jobs will require only very low skills.

Whereas the city's declared ambition is to attract high tech companies and to create a higher skills base, its low skills/low wage economy seems to be self-perpetuating[309].

In 1998 Peterborough, hitherto a *District Authority* of Cambridgeshire, became a *Unitary Authority*[310]*.* This status implies a severance of close connection with Cambridgeshire Council Council[311]. The effects of this change present a two-fold disadvantage.

Firstly, in the domain of ICT, Peterborough now has charge of its own computer provision, and although both Cambridge and Peterborough are in the middle of 'refresh' cycles[312], overhauling hardware and software, there is no collaboration between the two cities in these processes. The Peterborough work is in the hands of a *Senior Business Transformation Consultant,* but it is unclear whether the post is a private consultancy or in-house[313]. The Cambridge work on ICT deployment is in the hands of the in-house *Head of IT*.

[307] Peterborough Evening Telegraph, Monday, [6th October 2008].
[308] Interview 35, and Evening Telegraph reports.
[309] Lower skilled workforce as compared to Cambridge and Huntingdon. (WM Enterprise Consultants, Peterborough Community Survey [2005]). In [2005] 15.3% of the workforce had no qualifications.
[310] If a town or city is large enough to function independently of the county or other regional administration, it can become 'unitary'. Unitary implies single tier, with responsibility for all local government functions within its area. (Interview 64).
[311] Interviews 51, 64 and 66. The populace in Peterborough voted against the proposal to become Unitary. However a subsequent inquiry overturned this vote. Interview 66.
[312] Interviews 51 and 65.
[313] The Head of ICT at the City Council, and line manager to this position, briefly interviewed, holds the post interim; he leaves August 2009, and could offer little information.

Secondly, semi-formal networks of Cambridge local government employees, with their business links, which have the potential to release so much socio-economic capital to Peterborough may have been reduced[314]. A Peterborough initiative called Peterborough Regional Economic Partnership (PREP)[315] was to promote tourism to the town; it was deemed to have failed at the task[316]. The local paper suggests that Peterborough will now have to capitalize on Cambridge tourism[317]. Further interviews revealed that fortunately intra-sectoral networks of tourism officers, and the East of England tourism associations provide robust socio-business networks across county boundaries[318]. In this context there would be value in exploring the introduction an OKS to act as information pool for East of England cities in the tourism sector.

The social sector will be dealt with in the second part of this chapter. It presents a disturbingly bleak picture of severe deprivation in many electoral wards of the city, and an inability to attract high-flying research groups and firms, and the future does not look promising. Its relevance in this study is that it could exercise other aspects of the DE platform, notably in respect of support for economically inactive members of society. (See also Appendix B**,** Ch 2).

4.1 Environmental Goods and Services, Environmental Technology

> For emerging environmental reasons, industries now have to take into account costs which would hitherto have been written off as *externalities*. A recent plethora of regulations means that compliance costs must be factored into economic equations. UK Centre for Economic and Environmental Development (established in Peterborough) report for BERR (was the DTI) suggests:
>
> > ***Environmental technologies could reduce productivity*** simply because, whilst the *costs* of their development and adoption are counted, typically their primary *outputs* in the form of, for example, improved air quality, are not[319].

4.1.1 Environmental Goods and Services: EGS

Here is a set of definitions of EGS; no specific definition that has been accepted as the basis for reporting official statistics.

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[314] Interviews 12, 19, 29, 35, 42, 45, 50, 57, 58.
[315] PREP was a voluntary organisation consisting of members from the private and public sectors aiming to define and deliver a strategy for economic growth in Greater Peterborough. Funded by EEDA. PREP is now merged ‘Opportunity Peterborough’, see text *infra*.
[316] Peterborough Evening Telegraph, February 6, 2008.
[317] The Tourist Office figures list Cambridge tourism as worth £334M pa, employing 6,500 people, and having 4.6M visitors pa.
[318] Interview 68.
[319] BERR Report [2007]

1. *OECD/Eurostat*: EGS comprise activities which produce goods and services to *measure, prevent, limit*, *minimise* or *correct* environmental damage to water, air and soil, as well as problems related to *waste*, *noise* and *eco systems*[320].
2. *Defra/DTI* Environmental Industries are considered to include the production of *pollution control equipment*, *cleaner technologies and processes, renewable energy and waste management*[321], deriving activity from these sub-sectors: air pollution control, cleaner technologies & processes decommissioning/decontamination of nuclear sites, environmental consultancy environmental monitoring, instrumentation and analysis, energy management/ efficiency, marine pollution control, noise and vibration control, remediation and reclamation of land, renewable energy, waste management, recovery and recycling, water supply and wastewater treatment[322].
3. *Defra*: *environmental technologies* are 'all technologies whose use is *less environmentally harmful than relevant alternatives*, OR *end-of-pipe technologies that clean up pollution*'.
4. *Bartzokas and Yarime*[323] define *end of pipe technologies* as those that *are added to the final stage of the production process*, the application of which requires little change in the production process[324].

The Defra/DTI Environmental Industries Unit undertook a study of the EGS sector in August 2004, which sought to identify the size of the UK sector. The study used both a narrow and wider definition of the EGS sector based on the Standard Industrial Classification (SIC) codes:

- Narrow definition**:** (1) recycling of metal waste and scrap (2) recycling of nonmetal waste and scrap (3) collection, purification and distribution of water (4) demolition and wrecking of buildings; (5) earth moving (6) Wholesale of waste and scrap (7) sewage and refuse disposal, sanitation and similar activities
- Wider definition**:** *As above plus* (1) making of civil engineering constructions (2) construction of water projects (3) plumbing (4) other building completion[325]

[320] *Eco-industries products and services***,** defined by the OECD/Eurostat is the same as EGS.
[321] *Environmental Technologies and UK Productivity*, Final report to Defra, June [2007]. Segal Quince and Wicksted (SQW) was commissioned by Defra in November [2006] "to identify, critically analyse and synthesise evidence on the potential contribution that environmental technologies can make to the UK economy as a whole".
[322] Report by UKCEED, *Innovation in Environmental Services* [Dec 2007] for BERR; and *A Study of Emerging Markets in the Environmental Industries Sector* [2006].
[323] *Technology Trends in Pollution-Intensive Industries* [1997]. Discussion paper 06, UN University.
[324] Hence the name *CATNIP technologies* (cheapest technology not involving prosecution).

4.1.2 The Difference Between EGS and Environmental Technologies

The BERR Report says this:

> *Environmental technologies* can be distinguished from *environmental goods and services* in the sense that the first can refer to disembodied knowledge and techniques designed to minimise adverse, and maximise beneficial environmental effects, whilst the second term refers to the *embodiment of such technologies in traded goods and services*. However, the literature demonstrates that more is known about environmental goods and services mainly because the latter has been easier to define and measure.

4.1.3 The Market in EGS

UK EGS had an estimated turnover of £25 bn in 2004, with water and wastewater treatment coming in at £9.4 bn, waste management at £8.1 bn, and far behind energy management at £2.6 bn[326].

We know that the market is as large as that for pharmaceuticals, but not growing so rapidly. It is dominated by waste and waste water treatment management, these grow slowly, whereas demand for clean technologies grows faster[327].

Much hinges on the combination of consumer appreciation or demand for eco-friendly solutions, and improved competitive advantage being acquired by adopters/first movers. Technologies that are resource use-enhancing and drive costs down will naturally be popular.

[325] *Innovation in Environmental Services* [Dec 2007] by UKCEED for BERR, P18 also P67 offer even more definitions.
[326] UKCEED [2006] report
[327] BERR [2007] report provides figures for national, European and global demand.

4.1.4 Drivers & Barriers to Accepting New Environmental Technologies

- **Barriers** are (eg) reluctance to adopt where an entire production process will as a result need to be overhauled, which is why (cheaper), end of pipe solutions are more popular. eg water *treatment* rather than minimising *waste production*. This reason also accounts for the development of carbon capture and storage (CCS) technologies in recent years, (eg) diesel cars where additional filters (end of pipe) solutions which currently reduce emissions more effectively than eco-design diesel cars (which would be cleaner)[328].

- **Drivers**: come in the form of new regulations, ranging from environmental taxation (e.g Landfill Tax and the Aggregates Levy) through regulatory quotas (Renewables Obligation) to tradable permits (EU Emissions Trading Scheme), with particular focus on climate change, waste and air and water quality[329]. Defra (2004) reports that IPPC, a standards based technology forcing approach to pollution control and prevention, has been driving the take up of waste water and water treatment technologies among the manufacturing sectors in recent years. Mazzanti and Zoboli (2006) found that *group membership and networking*, more than firm size, can act as positive innovation drivers at firm level.

Dewick and Miozzo [2002][330] examined the implications of regulation for the adoption of sustainable technologies in the domestic sector of the construction industry in the UK, using thermal insulation as an example. They concluded that there was *a clear need for well designed buildings* regulations to meet emissions targets and encourage innovation, and pin-pointed the construction sector's 'conservative attitude towards innovation is *characterised by small firms where innovation is relatively slow to spread'.*

This does not reflect the attitude found by this study amongst a small sample drawn from low carbon engineering consultants, water engineers and international construction businesses – all SMEs - in the Peterborough area[331]. These interviewees criticised the way construction industry processes were organised (see boxed essay), and the poor materials in use. They stated that superior methods and

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328 See BERR report s7.3 for Barriers section. The report states that R&D in the sector remains heavily dependent on government intervention, at P40.

329 UKCEED report and Joint Environmental Markets Unit (JEMU) [2002] report, *Global Markets and the UK Environmental Industries Opportunities from 2010.*

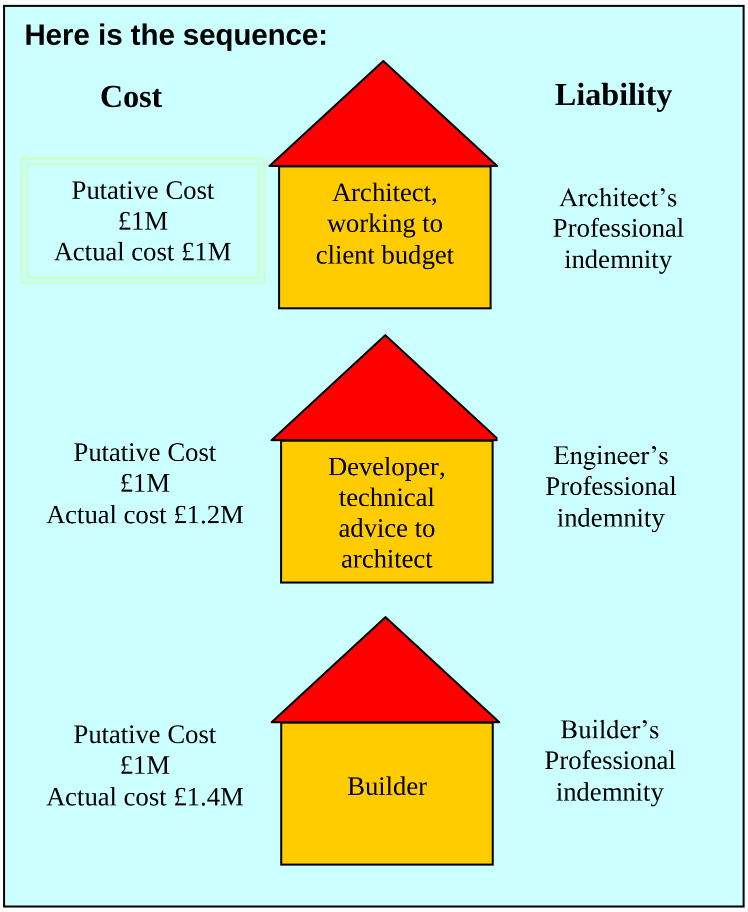
330 Dewick & Miozzo, M. 2002, *'Sustainable Technologies and the Innovation-regulation Paradox'. Futures*, vol. 34(9-10), pp. 823-840.

331 Interviews 52, 57, 66.

materials were the norm in other parts of Europe, (eg) Holland, and successfully deployed there for over 25 years. They criticised the BRE building regulations as inadequate to deliver buildings performing to meet the specifications.

Interview 57

Interviewee R believes that the conventional construction process chain harbours flaws and disconnects. These are indicators of the reasons why poor buildings with inadequate energy balances are destined to be produced in UK unless the linear hierarchy of the processes and their agents: architects, developers and builders is abandoned.



The disconnect comes where the cost of the building ought to escalate if it is properly to fulfil the specification.

Since this 'can't be allowed to happen', core functional items in the build are known to be sacrificed to keep costs within bounds.

The fault initially lies with the BRE Guidelines, which fail to use a methodology that requires successive stages to be properly validated or verified as they are completed.

The result is that the performance of the house is poor to disastrous.

The interviewee believes that in UK building practices we lag behind Germany and Holland, both in CAPEX and OPEX[332] arrangements. In heating design the norm is to specify (1) a green method of heating with (2) conventional (gas boiler) back-up.

The former (green method) is often specified to serve in the coldest possible weather (ie highest demand possible) and works inefficiently or not at all at lower demand.

The latter, (conventional backup) on the other hand, has its specification whittled away (since it is merely back-up) to cut costs en route down the process chain, until it under-performs. Thus when the green method collapses, and the back-up under-performs or malfunctions, the result is that the building performs very badly as a whole.

Highly developed (read that as expensive and from huge firms) specifications are subject to the tyranny of the pricing structure and the liability structure, see figure. If a building method can be implemented that cuts the build-time, those higher up the

[332] Capital and Operational Expenditure.

chain can frequently retain the full initial estimate cost awarded, not passing the savings up to the client.

END OF INTERVIEW

R identifies a niche for agile companies, notably at stage 2 in the figure, where independent consultants are prepared to take time to research on behalf of the client, which it is not particularly in the interests of the larger developer to do.

Similarly, R describes how pooled methods of collective heating, for example, a whole housing estate, industrial estate, or group of municipal buildings can yield the greatest savings of all. ‘Community will’ is implicated. The savings under such schemes can support another community scheme, building in a social benefit.

R reports that the entire housing sales system in UK is geared to *unit house price* with no thought of infra-structural support. Few schemes include utilities. Thus it is irrelevant to the house creation agent chain whether the utility bills are low, high or exorbitant.

Much of the rental sector is geared to flat rent without regard to the OPEX costs implicated in service supply. With ‘hot office’ schemes (‘all found’) and more community-based schemes, resisting the purchasing atom, which the corporates prefer.

The adoption of a DE would fit this social spiral of benefit and support community schemes and shared knowledge, which might avoid the demarcation issues outlined by the interviewee.

Interview 52

Business C specialises in ICF (‘incomplete concrete forms’) construction. The proprietor learned his trade in the Newcastle shipyards where luxury liners were fitted out. His extensive knowledge of wood, joinery and carpentry led him to diagnose faults in many modern buildings as due to poor curing of the timber used, and consequent warping of the structure.

His construction firm abandoned timber when he discovered more advanced methods being used by American builders in the Bahamas.

He has now developed a process that even sources its raw material cement from a quality-controlled supplier. The process prescribes the constituents and methods of making the forms. Production of the ICFs can operate on the building site itself, expediting the build. The strictly supervised build allows an entire project to be completed within a matter of weeks rather than months.

Rigorous environmental performance of these buildings has been demonstrated, and they have been tested overseas as hurricane proof. Their projected lifetime is around 200 years. Proprietor C believes that the key to success of the method is to counteract the weakest link in the building chain, which is poor craftsmanship. He therefore undertook a two-year project to produce an all-trades training manual for his ICF method of construction, but regards this is

insufficient without its use on certificated courses. Unfortunately he was given no public funding in the enterprise.

All components used by firm C in a given build specification are marked with their position in the final structure, and any unused parts are returned to base. Since lack of use of any component required for the building implies a fault in construction, pre-emptive diagnosis of flaws becomes relatively easy, and insurance costs are commensurately reduced.

The interviewee maintains that current architects' standards are '10 years out of date'. He has now, through informal networks, set up his own links with Cambridge University groups interested in better building techniques, but this forging of links was a protracted and time-consuming task.

End of Interview

Conclusion: A DE's role in this scenario

The processes described in the two case studies are clearly complex, and timing and reporting stage by stage events are critically real time. In the second to these studies DE/OKS developers could produce an analysis from which to derive technical requirements for a digital platform to service the processes. A DE/OKS adapted prototype could form part of the training and implementation method described.

Proprietor C is a firm friend of the OPAALS project, and has many communitarian goals in the overseas deployment of his construction method[333]. His ambition is to build 'the perfect house' regardless of which stratum of society's housing need is being satisfied. C is looking for ways to integrate our architecture and its deployment into his development.

4.2 Peterborough in Context

4.2.1 A Technology and Innovation Profile of the East of England[334]

Arthur D Little's regional report identifies an EGS sector[335:] comprising 2,186 environmental companies and organisations in the UK's Eastern region, which together employ 60,0000 people with an estimated turnover of £7.2bn[336].

[333] Contracts finalized in the Philippines, contracts under discussion in Brazil.
[334] Arthur D Little report of [2003]
[335] See also *Warming to Cleantech: Financing Clean Technology Companies with Public and Private Equity*, Report by Library House, Cambridge [2006], sponsored by Nabarro Nathanson and the Carbon Trust; *Investment Trends in UK Clean Technology 2000-2004,* a study commissioned by the Carbon Trust and carried out by Library House, publ. May [2005].
[336] *State of the Regional Economy, the East of England EcoDirectory,* published [2003].

It also identifies a *"Cleantech mini-cluster***"** around Cambridge with strong links to Cambridge University[337]. It reports one estimate stating that companies within the Cambridge area received 16% of the total capital inflow to UK clean technology.

4.2.2 The Natural Advantages of the Eastern Region:

- The East of England has a long and shallow coastline, and significant areas of agricultural land. Therefore the potential for generating renewable energy – through wind, wave and tidal power, and energy crops – is substantial.
- According to Renewables East – the agency responsible for renewable energy in the East of England – by September [2006], the region had installed generating capacity of 384 MW renewables; its target for [2010] is 1192 MW. Of current capacity, just under half is derived from landfill gas and about a quarter from each of biomass and wind[338].
- The Regional Development Agency EEDA has a tranch of ERDF funding running 2007 to 2010, dedicated to the overarching theme of the low carbon economic growth in its six Eastern counties. The proposed joint Peterborough City Council/OPAALS bid was to have come under Priority Axis 1: *Promoting innovation and knowledge transfer with the intention of improving productivity*.

4.3 Peterborough's Environmental Sector Support Structures

Government and RDA[339] intervention in Peterborough has provided interim subsidy for a number of structures and initiatives to be set up around the environmental goods and services sector. However, funding for many of these amounted to just a few years. Some have managed to attract private funding[340] and survive but still continue advertising for further support. Others have lost their RDA and other public support and are required to survive on consultancy and research[341]. The Eco-innovation Centre received very small amounts to refurbish an old building in the city centre. It lets units of office space and virtual

[337] Cambridge University has been named one of six research hubs in the Biotechnology and Biological Science Research Council's new £27m Sustainable Bioenergy Centre (BSBEC). Paul Dupree leads Cambridge's *Cell Wall Sugars Programme* to develop strategies to improve plants and enzymes so that more sugars can be obtained from plants. These sugars are convertable into biofuels. Business Weekly, [Jan 28th 2009].

[338] *East of England Renewable Energy Statistics*, publ [October 2006], Renewables East.

[339] The local Regional Development Agency is the East of England Development Agency. This body has had funding from central government and from Europe. Overall funding has been reduced for at least 3 years leading to 2009. Interview 21.

[340] For example, the Envirocluster initiative, designed principally to attract new business into Peterborough, whilst attempting to network and consolidate existing environmental firms.

[341] Such as the Centre for Sustainable Engineering, where public funding finished at the end of May 2009.

office facilities to small businesses and is making vigorous attempts to act as an incubator.

4.3.0 Evolution of the Environmental Co-ordination Community

The key players in the city's attempt to emerge as an environmental capital are mapped in the diagram below. These are housed mainly in the recently opened Eco-Innovation Centre (EIC). However, such is the constant shift of emphasis amongst these key groups, with atrophy or moth-balling of some of them and import of others, that the Cambridge partner has constantly to re-map their relationships, personnel and changes.

A research aspect of these shifts is where members of the groups leave, and assumed established contacts on a network are lost. From the viewpoint of the internal well-being of this community, commentators such as Sennett would at this point look for stress in employees whose roles were dislocated so frequently[342]. A core of optimistic people remain in the Centre with newly defined roles, some having shifted from one group to another, one with the role of managing the public interface for several groups, but there have been casualties, and the introduction of new and forceful personalities has apparently further rearranged the landscape.

[342] Richard Sennett, *The Culture of the New Capitalism,* Yale [2006].

The Eco-Innovation Centre

Funding for the groups below is increasingly private sector sourced.

Reviewed annually.

- Opened 16 November 2007
- *'Joint partners: CSEng and UK CEED'* to be the anchor tenants, acting as advisors and mentors to the start-up and young companies that move into the Centre.
- Few of the companies renting units actually aspire to ET research.

houses

UK Centre for Economic and Environmental Development

- Founded in 1984. New CEO appointed 2009.
- An 'entrepreneurial charity'; declared aim to 'promote the business case for sustainable development policies and actions'.
- Spent its early years (throughout the 1980s) in Kings Parade, Cambridge. David Cope (Fellow at Clare College) became Executive Director in 1986. Academics in Cambridge that remembered UKCEED lost contact with their colleagues on the staff when the organization moved.
- None of the original Cambridge UKCEED staff could be traced, leaving a gap in the organizational history.
- The advent in Peterborough was serendipitous. One interviewee, a previous employee of UKCEED gives the reason for moving as the very high rents in Cambridge.
- UK CEED refers to itself as 'an evidence-based organisation' reporting advice to government policy makers.

Centre for Sustainable Engineering (CSEng)

Set up by UKCEED in 2004.

'an independent knowledge house in the market adoption of cleaner technologies'.

At first outstripped UKCEED in importance

Brief to advise on business ideas, likelihood of their viability, estimate time to market and cost.

Ran a technical due diligence service for professional investors

Claims to have assessed over 600 technologies and advised on around 250 business plans.

Lost funding end of May 2009, tried to survive on consultancy. Facilities were always limited: one workshop. Coupled with constraints on time this reduced *research time* to around 1.5 days per week per member; achieved 1 patent [2009].

Now one employee remains; the rest have become 'associates'. One moved to Renewables East, which has opened an office at EIC.

Sustain IT, child of UKCEED

- Brief to explore the relationship between ICT and sustainable development.
- Stated aim to 'develop online tools and guidance materials'. These are its services:
- Evaluating benefits of core ICT technologies: broadband, wireless networks and mobile telephony; evaluating companies' use of ICT against sustainability measures.
- Developing an online toolkit for assembling documents to match against project outlines, appraisals and funding proposals to check for compliance.
- Its last newsletter was published August 2008,
- The Project Manager left the post in early 2009. That role then passed to the then Head of UKCEED, who has since left his post. Currently seems to be moth-balled.

Envirocluster

- An 'initiative' run by UK CEED to encourage and connect EGS start-ups and attract inward investment in the *Greater Peterborough Growth Area*
- Lost earlier public funding; and is surviving on private sector sponsorship.

Comments on the Investigation the Groups in the Diagram

Interviews revealed that the constituent agencies (UKCEED and CSEng) had to wait 2 years for the meagre funding which finally allowed refurbishment of the old building to serve as their base; on the upper floors is rentable space for companies. The environmental complex and its home, the Eco-Innovation Centre (EIC) have received relatively tiny public funds, including £500,000 from EEDA as seed corn, and £200,000 from the Engineering and Physical Sciences Research Council (EPSRC). It also received some support from the local firms of Perkins Engines (now Caterpillar), Peter Brotherhood the advanced engineering (now Dresser-Rand) and Peterborough City Council.

Although one interview was conducted with UKCEED, the time was spent explaining the OPAALS project to the person in charge of computer services, which were fairly rudimentary at that stage[343]. However, insufficient technical knowledge on their part hampered transmission of OPAALS goals and construction. The interviewee left the organization in 2008[344]. An eco-architect based in Cambridge with substantial personal social networks remembered UKCEED in its Cambridge days, but has lost the connection[345].

CSEng at one point in 2008 set up three separate units and made a start on advising policy makers[346]. It had a substantial staff, most with an engineering background. It had dwindled to near closure by the middle of 2009[347].

A joiner [2009] at EIC is **Renewables East**, a not-for-profit organisation receiving public funds, yet referred to as a company. RE was set up by EEDA in 2003 with a collective of stakeholders, from both public and private sectors. It has a Board of non-Executive Directors and a company membership comprising many of the original stakeholders. The body gathers and reports energy statistics. Since its brief operates across county boundaries, it can derive funds from EEDA (core funding), the East Midlands DA; Essex, Cambridgeshire and Suffolk County councils, BERR (was the DTI), the European Union, and the East of England Government Office (GO-East), all departments of GO-East are located in Cambridge.

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343 Interviews 3, 42, 29. Interviews with UKCEED's CEO and his assistant were hard to obtain: the staff relied on consultancy income to support the organization, and cancelled several appointments. Both these staff members have now left; one has his own consultancy.
344 Interview 13.
345 Interview 42.
346 It was the strategic partner to the *Engineering Technology Board* (ETB) in that organisation's analysis of sustainability [2005]. Also it is a panel member representing sustainability issues on the new British Standards Institute *Design for Manufacture Standard*.
347 Interview 69.

The influential **University of East Anglia**, the earliest UK higher education adopter of Environmental Science as a discipline, with its strong ecological departments may open an office in the EIC.

Opportunity Peterborough[348] is Peterborough's *urban regeneration company* (URC) - a private sector-led organisation, funded largely by the public sector, which aims to secure regeneration of the social, physical and economic environment of Peterborough, and working out of the City Hall. Its funding partners: Peterborough City Council, English Partnerships[349] and the East of England Development Agency. One of the reasons for Opportunity Peterborough being established as the UK's first 'growth' URC was to bring a private sector approach to the development of the city.

The Greater Peterborough Partnership[350] fulfils the holistic brief of trying to unite representatives from the public, private, faith, community and voluntary sector to work collectively together. GPP's role is '*to facilitate joined up work'* and to ensure that the work of the individual partners is targeted at collectively agreed priorities. It can also oversee commissioning of services and projects to help deliver the aims of the Sustainable Community Strategy. This role covers child welfare, community cohesion and safety, health, neighbourhood regeneration and adult learning and skills,

In spite of these goals, interviews with local pastors and church representatives paint a bleak picture of small effective assistance with their problems. In efforts to combat this lack of engagement, one pastor has taken his ministry onto the streets to try to identify the problems that most exercise his parishioners[351].

Peterborough City Council has adopted a more corporate structure in recent years; its principle goal is to remain within budget and be compliant with ever-increasing regulations[352]. Presentations from OPAALS fit one of the Priorities in ERDF Competitiveness Programme [2007-13], and Project Concept Form was being developed for a joint bid, with the City Council. The project was lost when the sponsor resigned and the residue of his department was merged into Opportunity Peterborough.

[348] The trading name of Peterborough Urban Regeneration Company Limited. URCs are companies approved by the government to drive the regeneration and redevelopment of key towns, cities and regions in the UK. They are independent bodies that combine both public and private support.
[349] English Partnerships is at root a developer's organization. **CHECK ALL**
[350] Alias the *Peterborough Local Strategic Partnership.*
[351] Interview 32.
[352] Interview 40

However, Framework 7's revised structure, with its new thematic priorities emphasises the importance of cooperative research and collective research[353]. This aspect of proposals is considered important enough to attract around 60% of the budget. Another influential City Councillor has shown some interest in the scheme, so the project may not be completely lost.

4.4 Barriers to Adoption of Open Source Platforms in Governmental Agencies

This section summarises the barriers that municipal hubs present when it comes to implementing Open Source software platforms and services. Such software has the merit of avoiding repeat license charges and the legal implications when licenses expire. The chore of software license audit is reduced. In addition, such solutions hold out the possibility of avoiding Help Desk charges. They have an option to tailor systems for local use, whilst at the same time providing jobs for graduates with OS skills. These graduates frequently trained in Universities that were Unix or Linux based[354] and have a pre-existing alumnus network (fellow students and staff) to call on for advice. The software itself is often proof against excessive version changes which may necessitate retraining and drain organisation resources still further[355].

So why would these publicly funded bodies resist such opportunities? Interviews with County, City and District Councils in the Eastern Region generated the following list of barriers[356].

1. The procurement of computer goods and services in Shire and City Councils (higher tier) frequently work independently of their own District Councils (lower tier), so there is no room to discuss a cooperative decision to change platform[357]. The software 'refresh cycles' of these entities (about every seven years) may be asynchronous.

[353] *Supporting SME Participation in Research Framework Programmes,* P6. EC Directorate-General for Research , SME Unit [2007].
[354] Many Universities were early adopters for cost cutting reasons.
[355] *Barriers to Adoption of Open Source Software in Government Agencies,* Jo Stanley: paper accepted for the ISBE 2009 Annual Conference, [2009].
[356] Interviews 34, 40, 51, and previous work for the *Small Firms Computing Project* commissioned by EEDA.
[357] The difficulties inherent in replacing a network are network effects. overturning a proprietary platform without an 'all jump together' strategy is extremely difficult without cooperative decsisions.

2. Procurement path structures in these organisations may be in flux due to changes of 'ownership of pieces'[358]. Organisations may need to carry out long-duration inventory-taking of software to determine *what they actually possess*, which chills any moves to further procurement, leave alone radical reform of software from proprietary to OS source.

3. The hierarchical nature of decision-making in municipal hubs means that, for example, a paper written by a technical department, perhaps recommending consideration of change in software type has to wend its way up a stack of bureaucratic handlers to CEO level. At that point, if the proposed change is substantial, consultation with elected Councillors may be precipitated. The recommendation is approved for further consideration or rejected. The information then passes down another stack to the software procurers, who have quite separate (in this case commercial) information from their technical colleagues who instigated the request. The process incurs considerable delays. Employees reared in the private sector are commonly used to speedily drawing on skills and knowledge from all over a matrix organisational structure, and find this structure frustrating[359].

4. Budget sources relate many-to-many to their uses. Part of funding may be from central government, part local. Some income from a combination of sources may be ring-fenced for special expenditure. Central government initiatives may release unexpected funding, or there may be 'emergency' diversion of funds from, say technical resource procurement, to social care. For all these reasons available resources can be hard to plan.

5. There are contractual legacies with obligations which may extend up to 3 years into the future.

[358] Responsibility shifts due to redesignation of roles, changes of actual individuals holding the posts, and other organisational flux, which usually means that the actual functions themselves are carried out conservatively.
[359] Interview 51.

6. The contracting process itself is heavily regulated. Procurement must be via *compliant channels.* This means that rigorous environmental, health and other requirements must be met by the software supplier, whose credit-worthiness and ability to continue to supply must be guaranteed. These compliances may be onerous on SMEs, and feasible only for major suppliers. The trend is for contract regulations to become yet tighter, and to change *in kind*, which precipitates re-learning the whole structure by the municipal employees involved.

7. Procurement must ensure 'fair competition' from bidders which causes slow down at the point of review of bids.

8. Although computer network infrastructure is directly purchased, network management is out-sourced, and regional procurement consortia with pooled budgets acquire the software, using intermediaries. There are a range of contract types. The goal is not to acquire optimal solutions but obtain 'value for money'.

9. It is hard to determine the overall cost of software (so as to compare it with an Open Source system of equivalent functionality) except by *retrospective billing analysis,* due to the 'distributed ownership' of 'pieces' of the process. There are complex cost models in use, and these may well change to accommodate the expected funding cuts due to the 2008-09 downturn.

10. Software procurement requires commercial knowledge, and software deployment requires technical knowledge. These two areas are kept apart by hierachical routes through the system, In fact they may clash if the technical side does not trust the market analysis proffered by the procurement side. Independent consultant advice is seldom sought as regulations dictate that not one but 5 opinions must be received and reviewed. The Councils can scarcely afford one opinion leave alone 5, so the project is abandonned and in-house (usually conservative) advice is taken.

4.5. The Employment Picture in Peterborough

There is little wrong with average employment *levels* in Peterborough. However the main sources of jobs come from sectors that characterise lagging towns. This section examines the sectors that dominate the city, and recounts recent job losses in the downturn.

In 2004, reports identify only 1.5% (1,400) employees working in the high-tech sector; only 4% of the businesses registered in Peterborough were in this sector[360].

The distribution, hotels and catering, and repairs sectors employ 23.6% of the workforce, public services: 22.1%, banking, finance, insurance and business services: 18.1%, and manufacturing industries: 16.1%. Major firms listed are Indesit, a factor for Hotpoint, Pearl Assurance, Peterborough Hospitals Trust, and the headquarters of Thomas Cook travel agents. Not only do these firms belong to sectors characteristic of '*lagging towns'*, but also such jobs are particularly vulnerable in the current economic downturn.

Friday, December 5th 2008 became known in Peterborough as Black Friday after more than 600 jobs across the city were cut. The following job losses were reported in the local newspaper[361]:

Finance

- Norwich and Peterborough Building Society (N&P) up to 40 jobs out of 483 staff were to go at the Lynch Wood headquarters in January 2009.
- 180 jobs were lost at insurance giant Pearl[362].

Distribution and Warehousing

- 400 jobs were cut at catalogue firm Freemans. (Peterborough has a strategic rail head and a great deal of warehouse capacity[363], hence it is the home of mail order firms, and retail storage, including Debenhams).
- Ideal Shopping Direct TV channel lost jobs (number unspecified).

Public Sector

- Peterborough City Council proposes to lose 400 positions over two years[364].

Industrial and Engineering

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360 *Annual Business Inquiry*, Office National Statistics [2006]. SQW in *Framework for Urban Collaboration in the East of England*, [May 2007] report a drop in manufacturing employees from [1998] 29% to [2004] 12%, with the finance sector employing 11.9% (over represented compared to the regional average). The Passport Office and Natural England in the public sector may be candidates for re-location. (Lyons Review).

361 Report from Stephen Briggs, 19 December [2008]**,** Peterborough Evening Telegraph.

362 Hitherto a major local employer.

363 The PACEC report, and interview 12.

364 Library staff at the City library are aware of the threat to employment in the government sector (Interview 64)

- Perkins Engines (Caterpillar) cut jobs in 2008, but that followed substantial downsizing when Caterpillar Inc. acquired Perkins in 1999.
- Oundle-based luxury yacht manufacturer, Fairline, cut 275 jobs due to the downturn.
- Early in 2008, 423 jobs were cut when Indesit ceased production of Hotpoint goods at Woodston.

By the end of 2008, 2,000 jobs had been shed in the city in the space of a few months.

Company B, an advanced engineering firm was selected as a case study, having excellent intellectual property, and a willingness to share information with the Cambridge partner. The relationship dated from the end of 2007 to mid 2008. The history of the company is boxed below.

During this time the Cambridge partner discussed with Company B issues to be addressed before the company embarked on joint projects likely to generate further (joint) intellectual property. The company did not appear to have taken professional legal or patent attorney's advice, and this move was suggested by the Cambridge Partner.

4.5.1 Case Study

Company B

- Advanced engineering company B (first established in London in 1867) moved to Peterborough in 1907. It was at some point acquired by US corporate A.
- Coming forward to March 2003, a management team acquired the business from its then American parent A.
- Since the buy-out the company more than tripled its then £25 million turnover, with workforce increase from 240 to 360 people. It was a leader in design and manufacture of steam turbines for the generation of electricity from renewable fuels (waste wood, sugar cane residue and domestic refuse), specialized in marine waste heat recovery, having 5 divisions and substantial land and plant in the city.
- B builds gas compressors for oil refineries and petro-chemical plants around the world. Its CHP (combined heat and power) systems provide highly efficient heating, cooling and electricity generation.
- It formed a South African subsidiary in [2003]; and opened an office in Beijing [2004].
- It was proud of its apprenticeships, much sought-after in the Peterborough area.
- At the time of the 2007 Peterborough Environmental Summit, B reported a joint venture with a major European wind turbine manufacturer, which was installing wind turbines across the UK and already in the later stages of development – jointly with Cranfield University – of a generator to produce electricity from wave power.
- Prior to July [2008] the firm announced a spate of contracts for its turbines with companies across the world, notably for use in the off-shore oil production industry.

At the time of interviews and discussions with the Cambridge partner in 2008 B was on the cusp of joint projects for a cooling system development for computer server centres with an American Corporate. The IP of the company was impressive, but unprotected by patents, which rendered the company in peril when bringing *background IP* to the discussion table where joint project, *foreground IP* might be generated. This company is one of very few with intellectual property that is patent-worthy in the city.

Earlier discussions revealed that B had not thought the expense and delay of the patent system were worth the effort of filing applications. Above all B was worried about the copyright situation as it referred to its designs, since it believed that other companies might derive work-arounds from the technical drawings if these were disclosed in a patent application.

- On Monday 30 June 2008 B was acquired by a subsidiary of a giant American Corporate for £31M (with year end adjustment of approx £6-7M more to come).

Thereafter a news black-out occurred.

Council agencies were unable to supply much information; no reports beyond the facts of the acquisition appeared in the local, national or trade press. It appears that the company is being dismantled and some divisions moved to the north of England. B contacts of the Cambridge partner reluctantly severed exchanges of information on their IP, as it was ‘now a matter of corporate policy’, so the case study was lost at that point.

4.6 Industrial Clusters in Peterborough

'When is a cluster initiative appropriate?

> 'Clusters *cannot be grounded in aspiration alone*, there needs to be substance as well. It is possible to start with very little but in that case *a commensurate level of investment must be committed <u>over a long period of time</u>*. … Moreover, there has to be a strong private sector commitment.
>
> The public sector can provide catalytic resources, but *unless leadership soon switches to the private sector* (albeit with continuing support from other stakeholders) there must be doubt as to how relevant the cluster approach is to be a business success. Perhaps the key question is whether or not there are significant potential benefits to be gained from closer collaboration.'
>
> Bill Wicksted[365]

Opportunity Peterborough has identified these clusters in Greater Peterborough.

Firstly ***EGS***, in which it includes environmental organisations such as Peterborough Environment City Trust and the UKCEED, the Environment Agency and Natural England. Joint Nature Conservancy Committee. The cluster is said to employ more than 4,500 people, the dominant subsectors being water management and water/wastewater treatment, energy management and emissions control[366]. UKCEED reported mapping the Peterborough cluster in [2000-01] and finding 250 environmental sector organisations, with 4,500 jobs and £340m plus turnover. Their subsequent mapping [2007] indicated increases to 290, 5000+, and unknown respectively.

Secondly, the ***financial sector*** is estimated to employ more than 7,000 workers.

Thirdly, the fenland around Peterborough has long supplied root vegetables for the London markets, sugar beet for the refining factories, and other produce for canning factories. This is termed the ***food and drink cluster***.

The relatively prosperous city of Peterborough has, in recent years, witnessed an influx of migrant labour.

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[365] *Clustering, Collaboration and Competitiveness* Bill Wicksted the author of *The Cambridge Phenomenon* [1985], addressed to the Planted World Conference, Dublin, October, [2004].

[366] The Peterborough Summit Conference of [2007] gives indication of the 'liberal' definition of a cluster. Jonathan Selwyn, Head of UK CEED until [2008] description of the sector sweeps wide: the term 'environmental organisation' seems to include Natural England, Environmental Agency, the Wildlife Trust, UKCEED, (its child organization CSEng is listed as a separate entity). Lists of environmental companies also sweep broad, to include builders' reclamation yards and mushroom farms There are 2 major domain sections within the UKCEED EGS category: **Pollution Management Domains** and the **Resources Management Domains**, within the latter recycled materials has a very broad scope. (Based on OECD/ Eurostat definitions).

However, with substantial immigration, the growth in employment agencies and gang-masters, both of whom have come to play a significant role in delivering workers to the food industry in the area has accelerated. Bad practices have occurred in the name of providing cheap labour to the sector. The migrants ignorance of pay, conditions and entitlement can expose them to abuse. This interface between agencies and new arrivals was found to undermine social cohesion when these practices restricted the possibility of new arrivals experiencing the values of fairness and tolerance. This situation combined with low wages, limits their social life in the city[367].

Around 4,200 farms support 11,400 farming jobs while 100 food manufacturers and 350 other food-related firms – including machinery and equipment manufacturing, cold storage, packaging, labelling and haulage – contribute an additional 7,300 jobs. Despite the decline in the food preservation sector, Opportunity Peterborough declares: ‘The aim is to move the cluster away from being primarily a group of low wage, low value-added companies to one employing a wider range of skills and technologies’.

Lastly, the ***advanced engineering cluster*** is identified. In spite of downsizing, its major companies remain as a presence, though acquired by corporates.

The dominant sector emerging from substantial studies seems to be warehousing, also it has more prospects of being added to, though the jobs generated would be predominantly low-skilled[368]. However Peterborough has been reluctant to accept the evidence of such reports, as they point in directions different from the aspirations of the city governance.

4.7 What Successful City-Regions Possess, and Failing Ones Do Not[369]

> The authors of *History Matters* maintain that it is necessary to ‘think large-scale and long-term, using an evolutionary economics approach to understanding change and innovation’. They comment that only *realistic expectations* should inform policy analysis and evaluation of specific initiatives.
>
> They remark the requirement for *international knowledge networks* as paramount. Their finding that Cambridge firms frequently declare their global networks as more important than any local ones is affirmed in the OPAALS study (Chapter 3).

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367 *Immigration and Social cohesion in the UK; The rhythms and realities of everyday life,* Mary Hickman, Helen Crowley and Nick Mai, [July 2008] Report from the Joseph Rowntree Foundation.
368 Interview 12.
369 *History Matters, Path Dependence and Innovation in British City-Regions* James Simmie, Juliet Carpenter, Andrew Chadwick and Ron Martin, July [2008], NESTA.

These indicators are looked for in the Peterborough context.

4.7.1 Measures of Success

Evidence of an Ideas Economy in Peterborough

A good measure for innovative activity in an economy is the number of patents obtained. The chart below outlines the numbers of patents obtained by Peterborough and its comparators in relation to Great Britain for the year 2005[370].

	Peterborough	Cambridgeshire	East	Great Britain
Patents	6	190	510	3,560
Stock of Vat Registered companies	4,480	26,200	188,000	1,790,000
Patent rate (%)	0.13	0.71	0.26	0.19

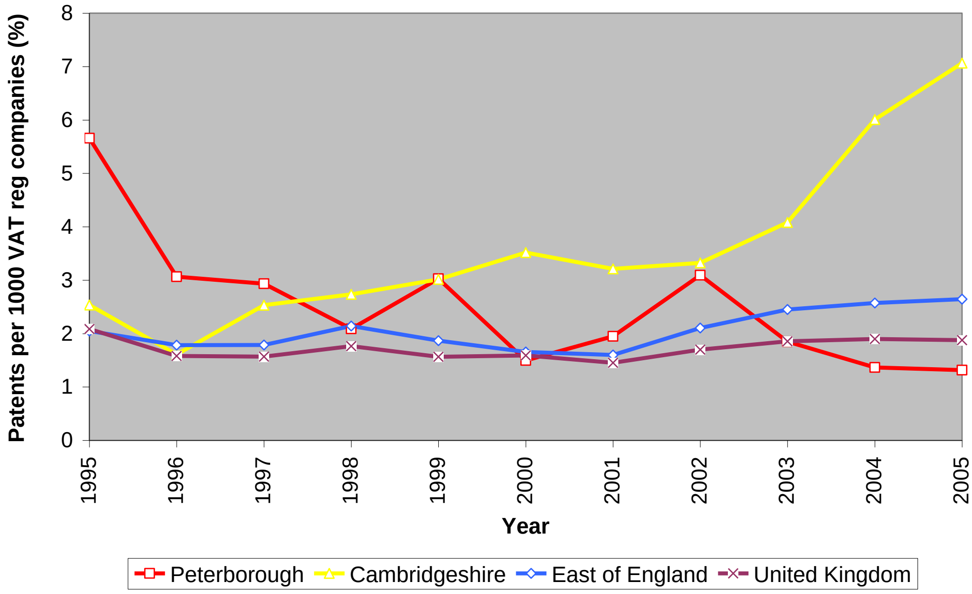
Number of patents obtained, stock of VAT registered companies and the patent rate in 2005

It is evident that Cambridgeshire and the East of England region are significantly more innovative than Great Britain as a whole. The patent rate of Cambridgeshire is over three times that of Great Britain, generating 7 patents for every 1000 companies as compared with 2 patents for every 1000 companies in the country as a whole.

Peterborough falls far behind both the East of England region and Cambridgeshire, and is below that of Great Britain, generating only approximately 1 patent for every 1000 companies. The graph illustrates the trends in obtaining patents experienced over the period of 1995 to 2005 by Peterborough and its comparators. Peterborough has witnessed an overall decline in the level of patents obtained. This steady decline is sharply contrasted by the rise in the numbers of patents obtained within Cambridgeshire.

The graph below shows patents obtained in Peterborough and each of the comparators (1995-2005)[371].

[370] Source: Patent Office; PACEC analysis.
[371] Kind permission of PACEC.



Neither discussions with the report compilers nor patent searches at the UK IP Office and the USPTO explained the high patent rate at Peterborough at the start of the reporting period nor why patent grants dropped in the city through the reporting period. A few inventors' names in key companies were identified, but none of the inventors could not be traced to obtain interviews.

4.7.2 Start-up Companies

Peterborough has the highest rate of VAT registrations of the comparators in the PACEC study, suggesting a high amount of enterprise activity in the sub-region. Between 2001 and 2006, the number of VAT registered firms in Peterborough grew by 14% from approximately 4,100 to 4,700, higher than any of the comparator areas.

Unfortunately Peterborough has a higher company death rate than its surrounding region (although similar to that of UK). This suggests that support may be needed to need those new companies.

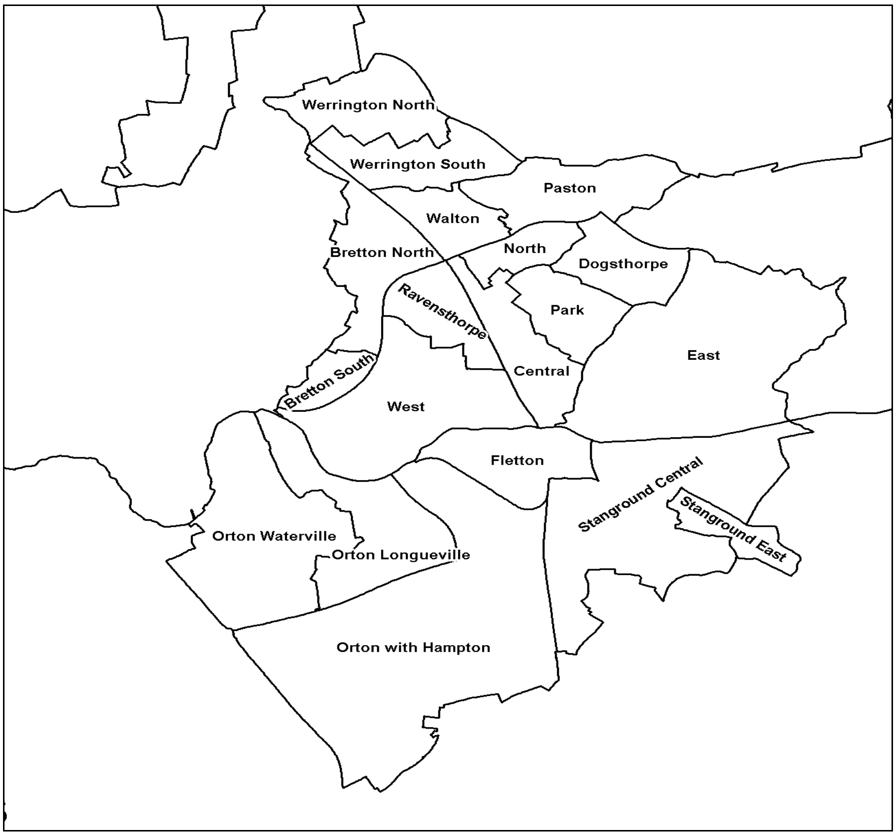
Part 2: Social Profile of the City

Peterborough is a city of extremes. One ward[372], Dogsthorpe, which was examined as a special study, is among the most deprived areas in England with some parts being within the 3% most deprived. A further seven areas are deemed to have high levels of deprivation.

These areas are characteristically linked to higher incidences of crime and disorder, health inequalities and barriers to higher education and employment

[372] Electoral district.

opportunities. By contrast, six areas are within the 10% least deprived areas, with some areas of West ward being within the top 2.5%. There are, in addition, some very wealthy villages towards to west beyond the city. National indices of deprivation ranks Peterborough as 80 out of 354 local authority areas, with 22% of the population of Peterborough living in the most deprived wards in the country.



4.8 The Indices of Deprivation: ID 2000 and 2004

The ID 2000 was published at *ward* level and, since then, the electoral wards in Peterborough have changed. The ID 2004 is available at *Super Output Area* (SOA) *level*.

SOAs are a new statistical geography developed by the Office for National Statistics. Each SOA is made up of a group of Census output areas, which contain, on average, 1,500 residents. As the ID 2000 and ID 2004 are based on different geographies, it is not possible to make comparisons.

The ID 2004 provides a more detailed local picture and has the potential to identify pockets of deprivation more accurately. There are 104 SOAs in Peterborough and 32,482 in England as a whole. ID 2004 identifies these domains of deprivation:

1. Income deprivation
2. Employment deprivation
3. Health deprivation and disability
4. Education, skills and training deprivation
5. Barriers to housing and services
6. Living conditions deprivation

4.8.1 Family Income

One proxy used for deprivation is the percentage of school age children needing free school meals, the highest being East ward at 29.6%, with seven additional wards having over 20%. In Central ward, 17.1% of children aged 0-4 live in households dependent upon workless benefits. In Dogsthorpe, the figure is 41.5%, in Orton Logueville, 34.8%.

4.8.2 Employment

Whilst there is a relatively high level of employment and average wages in the city, there are also a high proportion of people dependent upon benefits.

The Urban 11 urban regeneration programme (infra) gave Peterborough substantial funding to address its social problems. The URBAN II regeneration area, which corresponds to the (old) inner city, has high levels of long-term unemployment with, for instance, over 18% of unemployed people in Park Ward having been unemployed for over one year and all wards exceeding 10% long-term unemployment. Five wards within the URBAN II area are classified as being in the worst 3% of employment deprived (defined as those seeking but unable to secure work) wards within the Eastern Region. Youth unemployment is particularly acute with nearly 25% of those unemployed aged 16-24.

A doorstep survey in the Dogsthorpe area[373] showed that residence in the URBAN area is a disadvantage in terms of seeking employment. The residents have little or no access to private cars and experience difficulty getting to work across the city, due to inadequate public transport. The address is not seen as desirable by prospective employers.

[373] *Step One*, report [1997].

4.8.3 Health

A broad overview for 2009 from Association of Public Health Observatories concludes that although there is some improvement since earlier (annual) reports:

- The health of people in Peterborough is generally worse than the England average. Life expectancy for men and women continues to be below the national average.
- However, the proportion of adults on incapacity benefits for mental illness and the proportion of older people in poor health are lower than the England average.
- Peterborough is a relatively deprived area, with a greater than average proportion of people living in the most deprived areas.
- Inequalities exist within Peterborough by gender, deprivation, location and ethnicity. For example, men from the least deprived areas can expect to live 5 years longer than those in the most deprived areas.
- Early deaths from heart disease and stroke *have fallen*, Over the last ten years death rates from all causes and now appear to be levelling but still remain higher than the England average.
- Early death rates from cancer have fallen, in line with the national trend.
- Children's lifestyle indicators are worse than the England average. One in 8 children in reception classes at schools is obese.
- Rates of teenage pregnancy, children's tooth decay and smoking in pregnancy and breast feeding initiation are all worse than the England average.

4.8.4 Education

Education levels are poor with over 50% of adults possessing low numeracy levels and over 21% having low literacy levels. These basic skills problems are linked to the 37% of jobseekers within the area, who either have no or only elementary occupational skills. Educational attainment is below national average at all levels.

Sixteen to eighteen year olds face particular challenges in Dogsthorpe, Paston, Ravensthorpe and Orton Longueville.

4.8.5 Housing

Homelessness levels are above the national average, despite the relative affordability of Peterborough.

4.8.6 Crime

Recorded crime in the city is well above the regional average, with vehicle offences and robbery double the regional average[374].

Very high crime rates were a factor in the selection of the area for the URBAN 11 Programme described below. Reported crime in the URBAN II area is twice as high as for Peterborough as a whole. Drug abuse, robbery and racial incidents are major elements of the area's crime profile, which also points to a predominance of young offenders; 81% of all crimes are committed by offenders under 21.

4.9 Initiatives to Combat Deprivation

> Peterborough is the only city in the East of England to receive URBAN II European Funding. The assessors indicated that 'Peterborough's bid was the strongest and most closely fulfilled URBAN II objectives'. Specific criteria Peterborough answered were: long-term unemployment; a high level of poverty and exclusion; a high number of immigrants, ethnic minority groups or refugees; a low level of education and significant skills deficiencies; a high level of criminality and delinquency; a particularly rundown environment'. The project targets specific 'URBAN 11 areas which cut across ward boundaries to include 37,253 people from 73 'Enumeration Districts' having approximately 24% of Peterborough's population included[375].
>
> £6.5m has been allocated in total to specifically tackle urban deprivation through 3 priorities: To improve community access to information and advice. *Outcomes* to include increasing the number of young people continuing in education. To improve the living environment. *Outcomes* to include reducing levels of crime. To encourage the development of an enterprise culture. *Outcomes* to include reducing unemployment to the Peterborough average and obtaining additional investment to the area.

The ID 2000 finds *Central* ward is in the worst 1% (national ranking), *East* in the worst 3%, *Dogsthorpe, Ravensthorpe* and *Paston* in the worst 10 -12%.

Central, East and Paston are designated multiple deprivation wards scoring positively against all six indicators listed in s4.8. The social exclusion suffered by the people living in these wards is compounded by the absence of services which might otherwise mitigate their disadvantage – community centres and services for young people, lone parents, older people and people with disabilities.

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[374] *British Crime Survey: Key Figures and Facts for Peterborough.* (GO-East, 14th June [2006].

[375] The participating agencies are the City Council, Cambridgeshire Police, the Greater Peterborough Chamber of Commerce, Training & Enterprise, Cambridgeshire Careers Guidance, North Peterborough Primary Care Trust and Peterborough Council for Voluntary Service.

These urban core areas are in the oldest parts of the city, and housed many of the workers in traditional industries of heavy engineering, quarrying and brick works, which have declined over the past 30 years.

*Centra*l is currently experiencing a rapid increase in the number of refugees and asylum seekers from Central and Eastern Europe. SQW reports Peterborough as one of three clusters in the region for the accommodation of asylum seekers. They say this:

> *The new communities of Peterborough are observed to be disproportionately heavy users of health care and other social services. High uptake reflects* ***generally poorly developed social networks and weak social capital****.*
>
> *Established communities show rapid growth of the town as a source of anxiety and stress*[376]*.*

Currently 120 languages are spoken in the city. The brunt of language issues falls on the local schools, some of which have 0% of children with English as their first language, and on the Police and Care services who need translators to be able to assist non-English speakers people needing to use the services.

The Dogsthorpe Ward Initiatives

Under the Greater Dogsthorpe Neighbourhood Management project, the ward was to receive £1.6 million for neighbourhood renewal[377]. Their Delivery Plan 2006-2010 published a report setting up the structure, roles and salary distribution in Feb 2006, yet there seems to have been no deployment of resources under the scheme.

Similarly the Salvation Army Good Neighbours project is peculiar to Dogsthorpe ward, though arguably need is as great in Central Ward.

Interview 32 with a pastor in Dogsthorpe indicated that initiatives fail to join up. He reports 90 different languages spoken in his area. To engage with his constituency he works a ‘prayer on the street’ scheme 2 days a week to locate the issues of concern by direct contact.

Initiatives that showed no inclination to join up are:

[376] SQW report for EERA, EEDA, and Go-East, *Framework for Urban Collaboration in the East of England*, [May 2007].
[377] Safer and Stronger Communities Fund - Neighbourhood Element.

Great Dogsthorpe Neighbour Management

[2006-10 delivery plan]

- Total grant £1.6M
- 2006-07 £412K

The Dogsthorpe Partnership

The Dogsthorpe Development Group

Dogsthorpe Community Association

Residents Association

Support is available from

- 3 Councillors
- The Salvation Army
- Local Head Teachers
- Dogsthorpe library
- Evening Telegraph newspaper Community Section

Conclusion

Peterborough appears to be a city with declining social capital. The assessors judged that the local partnership which delivered the URBAN 11 regeneration programme had ‘a weak interface with the community’. The paucity of social well-being in many parts of the city, and the weak skills base tends to discourage high technology companies from coming to the area.

Knowledge creation and diffusion in the environmental cluster is hampered by the absence of a University at the heart of the city. A regional college exists there; Loughborough University once ran courses for 160 students, but left the city in 2002. There is a projected University Centre, a partnership with Anglia Ruskin University (Cambridge and Chelmsford). Planning permission has been applied for and funding allocated, but completion is some years away.

There is a plan for a ‘Carbon Challenge’ urban regeneration build on the south bank of the River Nene (south east town), and a developer consortium has been chosen for the first phase. This initial development is supposed to meet level 6 (zero carbon) environmental standards (hardly ever reached by buildings once they are in use). Eco-architects, construction specialists and eco-engineers are sceptical about the feasibility of such performance from any domestic buildings, as the technologies needed are in the main still immature[378].

There are many initiatives both at city and ward level, both commercial and social. Yet a cohesive pattern of division of labour and complementarity amongst them does not emerge. The top-down subsidy approach, with strict time limits on funding to new agencies is not robust if the agencies sink into a struggle to survive when aid stops.

More funds are sorely needed by the city, notably for social schemes but for the reasons given in section 4.4 above the adoption of a community digital platform is a hard thing to achieve, albeit a need is clear in social, local authority and SME sectors.

Summary of a Possible Role for a DE in Peterborough, and its Deterrents

1. Opportunities

- As indicated in s 4.0, tourism is a sector that would benefit from OKS/DE support, as would sectors with high volumes of regulatory materials

[378] For example, interview 63.

needed for compliance, hence firm survival: interviews 57, 52 s4.1.4, and the Q case study given in chapter 2.

- The ERDF bid (under priority axis 1, see s4.2.2) compiled jointly with Peterborough City Council should not be abandoned, but pursued via EEDA.
- The EU's Framework 7's revised structure, emphasising ***cooperative and collective research*** should be investigated, and may provide opportunities to develop a regional DE under ERDF.

2. Barriers in the Public Sector

- The disconnect in cooperative processes across levels of local governance in ICT procurement.
- Procurement processes within one hub involve multiple actors who do not share information.
- Hierarchical constructs for information flow cause delays and miss matrix communication opportunities.
- Multiple and ever-changing sources and sinks for funding militate against radical change and long term planning.
- Legacy contracts shackle radical changes in *types of software*,
- As does the installed base for proprietary software
- Regulations requiring compliance increasingly shackle the procurement process.
- Internal cultural changes within governance structures chill out change, and encourage conservative policies with respect to ICT procurement policy.
- Costing systems for ICT are subject to similar changes and delays.
- The voices of agents necessary to sensible procurement, such as technical staff, can go unheeded.

3. Future Action

- Framework 7's ***cooperation/collaboration*** commitment should encourage the OPAALS DE project to persist in enlisting RDA support in the region[379]. Talks with representatives in the newly appointed Economics Unit (April 2009) at EEDA indicate that there might be costings reasons to review alternative recommendations for digital provision.

- The best chance to engender initial interest in the DE project is to inform and to enlist the support of those local SMEs who have already shown an interest in the work. Many of these companies are disaffected with government agencies and initiatives, which some believe have consumed their core business time in presentations and meetings, but led to no fruitful outcomes. For this and many other reasons these companies are more likely to aggregate in an emergent network on their own[380]. These networks may prove stronger than imposed structures. They could then benefit from the DE's capability to offer direct collaboration capability without the need of intermediaries either at service or network level. This could speed up their response to business opportunities and changing market conditions.

- The loose coupling of deployed services to the network under the Surrey model avoids SMEs' obligation to reveal local implementation data. This, and avoidance of a single point of failure goes far down the path of sustainability. The dynamic (DVSP-based) network topology prohibits movement towards dependency on a few large enterprises. The small companies are agile and can aggregate to compete with large firms; and the P2P model is geared towards the kind of collaborative effort which the EC FW7 priorities for SME evolution so desires[381].

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[379] *Supporting SME Participation in Research Framework Programmes,* P6. EC Directorate-General for Research , SME Unit [2007].
[380] See the proposal for continued catalyst action in Phase 3 of OPAALS.
[381] I am grateful to Sotiris Moschoyiannis for collaboration in this section.

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