What is innovation?

It is obvious that ‘innovation’ is something new and in everyday language it has become used in this broad meaning; not least in recent years when the concept has become something of a buzzword. In this course we are interested in innovation primarily as it relates to economic development and management. Therefore we need a more precise definition.

We are going to follow other experts on innovation and separate innovation from invention. While invention refers to a new idea or a new concept while innovation refers to the actual introduction and use of the new idea in the economy. In market economies we might as a first step define innovation as the event when an invention is ‘brought to the market’ either as a new product or a new production process used to produce for the market (Fagerberg 2005F, p 4).

There is of course a problem with this definition since it would leave a ‘non-market’ economy without innovations. It excludes from the innovation category the use of new ideas in the public sector. To keep thinks simple we will nonetheless stick to the narrow definition. While renewal of processes and services takes place in the public sector and while this renewal deserves much more analytical attention than given to it so far, we propose that this phenomenon requires a different analytical framework than the one we will develop here.

In the mind of most people there is a close connection between technical change and innovation. The telephone, the car, the Pill, the Bomb, the Computer and the Web are all outcomes of processes of radical technical change that fascinate since they have changed the way we work, communicate and live. Schumpeter who may be seen as the grandfather of modern innovation theory gave a broader definition of innovation not only referring to technical change. He referred also to new
forms of organisation and to the opening of new sources of raw materials and new markets (Schumpeter 1934).

While we will follow Schumpeter and the majority of scholars in using innovation both for technical and for organisational change it is important to keep the two separate from each other in the analysis. One reason is that ‘technical innovation’ on the one hand and ‘organisational change’ or ‘institutional change’ on the other may be said to belong to ‘two different species’. While (some) new technologies are developed through search processes in laboratories and sometimes end up as proprietary knowledge, new organisational or institutional forms evolve in a much less systematic way and they seldom can be protected by intellectual right instruments.

The second reason for making a clear distinction between technical and organisational innovation is that the most important channel from technical innovation to economic performance is through the organisational and institutional level. Technical innovations will not have a major economic impact until the organisational and institutional context has changed so that the new opportunities emanating from the new techniques can be fully realised. Therefore it is not advisable to put technical and organisational innovation into the same category. We need to separate them in order to work out how they interact and co-evolve.1

Another issue is if new services should be seen as innovation. With the growth of the share of the service sector and with the increasing importance of service elements in tangible products it would seriously limit the relevance of the analysis if we were to focus only on material and tangible output. But also here we would insist that it is useful to look for elements of technical change involved in developing the new service and to separate these from the organisational changes involved. This is obviously possible for many important new services in telecommunication, banking, transport and tourism.2

1 There are now ongoing attempts to measure ‘organisational innovation’ in connection with work at OECD, and the European Community – questions on organisational change have been introduced in the Community Innovation Survey. A major European project MEADOW aims at measuring change in organisations and workplaces.

2 To define what is innovation in ‘creative industries’ such as art, film and music may be more problematic. Each single new piece of art, melody or film may be seen as a single innovation in such industries we would also focus on changes in products and processes related to new techniques and on innovations that give rise to regular production either as using a new process repeatedly or as serving a market. The introduction of DVD and other new means of communicating art and entertainment are important examples of innovations in creative industries.
The economic impact of innovation and the important distinction between process and product innovation

Innovations have changed the way we live, work and communicate with each other. In this paper we focus on the economic impact of innovation. Without innovation economic growth would be much slower in our economies and in many sectors it is a condition for survival for the single firm to take active part in the process of innovation. Therefore both those in charge of economic policy and those in charge of management need to be concerned about how far institutions and organisational forms promote innovations.

In order to study the economic impact of innovation it is useful to make a distinction between process innovation and product innovation. For the economy as a whole this may be seen as a distinction between innovation in semi-manufactured and capital goods on the one hand and innovation in consumer goods on the other hand. For the single firm it is a question if you want to use the new technique in house or if you offer it as a product for others to buy and use.

The core of production theory in standard economics is about process innovation and according to this theory the major impact of innovation is to raise the productivity of a set of already existing product lines. If this was what was really going on the limits for economic growth would be quite narrow. With more and less expensive commodities of the same kind as the major outcome the economy would at some time run into problems with saturation of needs and stagnation in demand.3

Therefore product innovation resulting in radically new goods bought and used by households is fundamental for sustained economic growth (Pasinetti 1981). For a national system the capacity of consumers to engage in learning how to use new products is an important factor affecting the economic performance of the economy as a whole. This is neglected in production models – here the consumer is assumed to be able to absorb whatever is produced without any difficulty.4

3 Scholars guided by this class of models will also be pessimistic regarding employment. Either process rationalisations ending in saturation of markets would have to be reflected in shorter working hours or in what has been called technological unemployment. Product innovations is the single most important factor helping to avoid both technological unemployment and de-skilling of the labour force. Establishing a new product line involves labour and skill intensive activities.

4 If you use search engines to look for ‘consumer learning’ you will find few references and these mainly refer to ways that consumers may be manipulated to prefer one product as compared to another product. The fact that using new
For the single firm product innovation has a different meaning. It is basically to develop a product with new characteristics addressed to an external user; be it a household, a public institution or another firm. When for instance firm A develops a new machine to be used in the production process of firm B, firm A develops a product innovation that turns into a process innovation in firm B. In principle we can choose to follow standard economics and neglect these transactions. We can leave the whole industrial system as a black box. The aggregate productivity growth may then be taken as an indicator of process change in the industry as a whole.

But this would make fundamental issues related to what drives innovation and its impact upon economic growth disappear (Lundvall 2006). If we compare two economies with similar product lines but with different internal industrial structure we might get very different outcomes in terms of innovation and growth. Assume that all product lines resulting in consumer goods in economy A are highly vertically integrated – then most innovations would be process innovations according to our definition. Assume, in contrast, that economy B is characterised by firms covering only a few steps in the value chain – here product innovation will be much more frequent. In this course we will argue that the dynamic performance of economy B would be stronger, and that this would be true especially in sectors with rich technological opportunities.

We are going to emphasise the importance of understanding how product innovations take place in the modern market economy. In this context we are going to show that some of the assumptions on how markets work need to be radically revised when we introduce product innovations (Christensen and Lundvall 2004). We will demonstrate that markets with professional users are organised markets and that they will involve interactive learning processes that are socially embedded. One radical conclusion from our analysis is thus that ‘pure economics’ cannot explain the dynamic performance of systems of innovation.

‘Radical fundamental uncertainty’ characterizes innovation

Fundamental uncertainty refers to situations where it is impossible for agents comparing between different alternative lines of action to define in advance all possible outcomes of the decision they have to make. Such uncertainty may reflect the complexity of the world and/or the limited household technology as well as driving cars and working on home computers involve a lot of competence building on behalf of the consumer is not reflected in the literature.
analytical capacity of the agents. In standard economics it is sometimes that we can assume away uncertainty and that agents have ‘rational expectations’ – they can foresee what is going to happen. When we analyse innovation we cannot assume rational expectations without running into logical difficulties. If all possible outcomes of the innovation process were known in advance we would not refer to it as an innovation. Innovations may be seen as new combinations of existing pieces of knowledge but since it is an innovation we cannot know in advance what specific combinations that may come out of the process. Actually we might go as far as saying that the only thing we know with certainty is that if the process is successful something unforeseeable will come out of it. We might refer to this as ‘radical fundamental uncertainty’. One major reason why economists have been reluctant to enter into an analysis of innovation is that it cannot be argued that a complete set of outcomes can be known for agents that engage in innovations (Verspagen 2005F, p.494). 

But different phases of the innovation process may be more or less loaded with respectively technical uncertainty and commercial uncertainty about outcomes. Early on in the process very different technical conceptualisations may be considered, later on some elements and characteristics of the new product are frozen and at some point you might have a rather clear idea of what the final result will be in technical terms. But still there is uncertainty about the how the product will work in use and connected to that there is commercial uncertainty to cope with. If there is technical novelty in a new process or a new product the innovating firm should expect surprises. It is neither possible nor rational to ‘debug’ a new product or process 100% and moving from prototypes to full-scale use is in itself a complex engineering task of trial and error (von Hippel and Tyre 1995).

Innovation is a cumulative process

While innovation always brings something new to the economy innovations never come out of the blue. Often they are steps in a long cumulative historical process. This is well illustrated of the history of the computer. When Babbage in the first half of the 19th Century first developed the idea and the prototype of a computer he had to use the knowledge and the materials that existed at that time.

---

5 Sometimes project management analysis based upon models of rational choice is applied to help management select between competing R&D-projects aiming at different innovations. This may give decision-makers some illusion of security when they make their choices but if they are experienced they will be careful not to take predictions of outcomes to literally. To give project leaders with a good track record and a good nose for success the last word may be a more reliable method than cost-benefit analysis.
time. The result was a clumsy construction made with ropes and with spakes and wheels made of wood. But his idea was kept alive through centuries and became of increasing relevance as the possibility to use electricity, as source of power, became a reality.

The first prototype of a modern computer UNIVAC was developed in the US and was first brought into use 1945. It was a monster in terms of size and energy consumption and the capacity to make calculations was far less than that of a modern portable desktop. In the fifties governments in most countries asked committees to pursue an analysis of the national need for computers and the standard conclusion was that one computer was needed and that it should be used mainly to register and make calculation in connection with population statistics.

Today the computer is everywhere and computers look quite different from the UNIVAC. Everybody in the modern office is expected to be able to use them and computers have become part of the standard household equipment, at least in the rich part of the world. Microcomputers may be used in human bodies to compensate for malfunctions. This story has been told many times under headings such as the ‘digital revolution’. What I want to use it for here is, to illustrate some of the important characteristics of innovation.

There might be tendency to see innovation as irregular discrete jumps and as events that can be given a date in historical time. The history of the computer demonstrates that if we want to understand such discrete changes we need to see them as part of on-going process. The computer story demonstrates that innovation processes are cumulative and path-dependent. Each step taken is based upon steps already taken by others elsewhere. Schumpeter one of the few major economists who saw the fundamental economic importance of innovation, talks about innovations as ‘new combinations’.6

This is very close to the truth since at closer scrutiny almost all radical innovations represent new combinations of elements that already exists. This is not so surprising since innovation is closely connected to knowledge and knowledge is cumulative. What we know today is obviously based upon what we new yesterday. This is true also for modern innovation research and therefore we will enter a brief history of innovation research.

6 Actually he explicitly refers to new combinations of production factors using the language of production function theory. I would argue that the metaphor is even more powerful when we apply it to combinations of elements of knowledge.
Innovation as an interactive process – a stylised model

Innovation may start with a new idea – an invention. But before the idea is realised there might be a reason looking for it. It may be a bottleneck in the production process or a malfunctioning of an existing product. It may also be a customer that expresses some new needs or a supplier that offers some new equipment that makes it possible to deliver a completely new service to customers (Pavitt 2005F).

In the firm, this may result in work taking place in the R&D-department with a team of experts experimenting with different configurations. During the process the team will need to get in contact and interact with knowledge institutions involved in research such as laboratories, universities or technological institutes, including institutes in charge of standards and intellectual property rights. Some of the problems can be solved more easily using results from natural science or engineering science and it is important to get an idea of state of the art regarding technologies as reflected, e.g. in existing patents. This is especially true for sectors such as ICT-, chemicals, pharmaceutical but the science base tends to become increasingly important for all kinds of sectors.

Later on a new type of team may be set up to design the new product. This team will often include employees with roots in different departments – such as R&D-, production and marketing departments. To find the right manager for the team is important; it is a demanding task for the leader since he/she needs to be able both to conciliate the different experts’ views and to represent the team in relation to the top managers of the firm. The team will need some protection from too much intrusion from the outside.

The team will need to interact with customers as well as suppliers while designing the solution. Customers will give feed-back on the user characteristics that they want. Suppliers of machinery or of technical systems will give feed-back on the technological opportunities that can be offered or developed in connection with the new product. Suppliers of materials will give insight in what are the alternative options that can be considered.

The proto-type may be tested first in-house in a laboratory situation and later it will be confronted with some lead users who will point out weaknesses with the new product. The first runs of production will demonstrate problems that need to be corrected before it can be efficiently produced. Only at this point will there be a full-scale production of the new product. To set up the process to do so may involve many complex problems related to the up-scaling.
The first generation of the new product will often prove to be far from perfect in terms of how it fulfils requirements of users and of the production department. Therefore soon new attempts will be made to develop an even better solution – sometimes this will take place in a competing firm and many steps in the process will be re-iterated.

This presentation of a typical innovation process is too simple since it operates with different ‘stages’. In real innovation processes you cannot move smoothly from one stage to the next. From time to time the design work will run into unforeseen problems and has to go back to an earlier step. The R&D-department may need to be called upon again and again to solve such problems and sometimes there will be a need to involve knowledge institutions in the problem solving. And vice versa it might be necessary to involve the production department in the testing of new ideas very early on (Pavitt 2005F).

But it follows from this stylised description of the innovation process that a key to success in innovation is ‘the quality of interaction’. The capacity of experts coming from different divisions to share knowledge and become a creative team is fundamental for success. The capacity of the team to interact with knowledge institutions, suppliers and customers is the other major source of success.

‘Quality of interaction’ is of course a difficult and multidimensional concept and in this course we try to specify some of the most important dimensions and trade offs. One way to get a very close and effortless communication and interaction is to bring together ‘clones’ speaking the same language and operating on the basis of frame of reference. But this would be detrimental to innovation since few new ideas would appear. Neither would it promote innovation if teams were without any common ground whatsoever.

When designing innovation policy and innovation management strategies it is a key to work out what ‘quality of interaction’ that should be aimed at. In some sectors very long term and stable relationships may be conducive to innovation while in others there is a need to renew the patterns of relationships quite often.

On the local character of innovation

On this background also better understand why policy makers around the world make efforts to get their own country or region ahead in the innovation race. The reason for this is that innovation is an interactive process and that some of the interactions will be localised rather than global. The
paradigmatic case of such local interaction is Silicon Valley. The story about how Silicon Valley became the global centre of developing ICT-industries illustrates the importance of local interaction.

According to ‘Silicon Valley Fever’ the main reason for why it happened the way it did was that William Shockley got pneumonia. To recuperate he went to visit his aunt who lived in California and since he found the climate more attractive he not only decided to stay but also to attract some of his most talented collaborators from the Bell Laboratories to join him in an attempt to develop the semi-conductor. This story, more or less true, gives us some insights in how ‘small events’ may change the history and geography of innovation. Of course the role of Stanford University and other specific factors made it possible for Silicon Valley to take off. But similar prerequisites may have been found in for instance Texas.

But when Silicon Valley had taken off it was ‘the quality of interaction’ that made it dominant in the world. In a new technology where the scientific foundations as well as the practical applications are still not stabilised face-to-face interaction and mutual trust among developers is necessary to make progress. ‘Silicon Valley Fever’ tells the story about the richness of formal and informal interactions and communications that evolved. The economic prosperity of the region was built upon social interaction and networking (Saxenian 1994).

A specific trait of Silicon Valley that might have helped to speed up the process was the high mobility in the labour market. High incomes and labour regulated short vacations combined in giving incentive to soft-ware developers and engineers to change jobs at least once a year to get a proper vacation. The absence of competition clauses, forbidden by law in California, helped in this direction. As experts moved from one organisation to another the inter-organisational networks they became part of became richer and through this mechanism new ideas were efficiently transferred across organisational borders.

There have been many attempts to replicate the success of Silicon Valley. But there are fewer successes than failures in this respect. Often it has been assumed that establishing a science park with public support money would trigger a building of a local dynamic network economy. Focus on techno-economic aspects and neglect of social and institutional dimensions have contributed to the lack of success. On the other hand there are examples of dynamic industrial clusters that have evolved without public support. To design regional innovation policy to exploit the local character of innovation remains a difficult challenge (Asheim and Gertler 2005F).
Radical innovations

Technical innovations have been defined as more or less ‘radical’ and it is obvious that sometimes the changes involved is minor and sometimes they are major. Distinctions may be made between imitation, incremental innovation and radical innovation. Imitation may be less demanding than developing your own innovations from scratch but to copy and imitate complex technologies is not at all a trivial matter. National efforts to build up domestic automobile plants or nuclear power plants already produced elsewhere may not succeed because the infrastructure and the skills are not present in the national economy.

One way to discuss the radical dimension of innovation is to break it down into at least three dimensions. The first refers to the degree of change in technical capabilities of the producer that is required, the second to the degree of new requirements to the competence of the user and the third refers to the economic impact. Very few innovations are radical in all these three dimensions. One of them is of course the computer.

Genetic engineering of new species represents a radical break with some of the old techniques on the supply side but for users the change from ‘natural’ to ‘artificial’ insulin is trivial. Neither has the biotechnological revolution had any major economic impact yet. There is a lot of patenting going on but the market volumes for end products remain small.

The other way a round, rather trivial innovations transferring a component, material or design from one area of use to another may have a major economic impact. One example would be the introduction of inflatable wheels already in use on automobiles on tractors in the first half of the 20th century. This very minor innovation increased productivity in agriculture substantially.

It is especially important to be aware of how far innovations are radical seen from the point of view of users’ competence requirements. The neglect of the need for user learning has from time to time brought the rapid growth in the ICT-sector to a standstill. And this leads us to the issue of how mismatch between technology on the one hand and skill profiles and organisational routines may hamper the diffusion and the impact of innovations.

Innovation diffusion, skills and forms of organisation

In the literature on innovation we find prominently a distinction between innovation and diffusion and sometimes the two are treated as separate processes. Diffusion processes are sometimes described as ‘epidemic distributions’ similar to the ones found when a virus diffuses in a
population. Early adoption goes slowly, is followed by a stage of acceleration and slows down when most of the population has adopted the new technology. Sometimes these models are explained as a process of information diffusion where it is assumed that the user will adopt the innovation as soon as she hears about it.

More realistic attempts to explain these patterns need to take into account institutional and organisational factors as well as the skill level of the potential users (Hall 2005F). Innovations with radical change in requirements in skill and organisation will only diffuse slowly and the diffusion will depend on learning processes where users and organisations become more competent. Empirical studies have shown that there are interesting parallels between the difficulties experienced when introducing of electricity and the current diffusion of ICT-technologies among users (David 1990). The weakness of the ‘new economy’ hypothesis where it was assumed that computers could raise productivity almost without limits had to do with the fact that users could not fully absorb efficiently use all the IC-technologies that they got access to (Lundvall 2002).

A historical sketch of innovation research

Innovation research starting with Adam Smith

The idea that innovation matters for the wealth of nations is present in the work of the classical economists. Innovation plays an important role in the introduction to Adam Smith’s classical work on the Wealth of Nations. It is especially interesting to note that he identifies and distinguishes two different modes of innovation (see Box 1 below). The first mode is experience-based and I will refer to it as the DUI-mode – learning by doing, using and interacting. The other mode is based upon science based search processes and I will refer to is as the STI-mode – science is seen as the first step toward new technology and innovation.
Box 1:

Adam Smith (1776: p. 8) on the DUI-mode of learning:

A great part of the machines made use of in those manufactures in which labour is most subdivided, were originally the inventions of common workmen, who, being each of them employed in some very simple operation, naturally turned their thoughts towards finding out easier and readier methods of performing it. Whoever has been much accustomed to visit such manufactures, must frequently have been shown very pretty machines, which were the inventions of such workmen, in order to facilitate and quicken their own particular part of the work. In the first fire-engines, a boy was constantly employed to open and shut alternately the communication between the boiler and the cylinder, according as the piston either ascended or descended. One of those boys, who loved to play with his companions, observed that, by tying a string from the handle of the valve which opened this communication, to another part of the machine, the valve would open and shut without his assistance, and leave him at liberty to divert himself with his play-fellows. One of the greatest improvements that has been made upon this machine, since it was first invented, was in this manner the discovery of a boy who wanted to save his own labour.

Adam Smith (1776: p. 9) on the STI-mode of learning:

All the improvements in machinery, however, have by no means been the inventions of those who had occasion to use the machines. Many improvements have been made by the ingenuity of the makers of the machines, when to make them became the business of a peculiar trade; and some by that of those who are called philosophers or men of speculation, whose trade it is not to do any thing, but to observe every thing; and who, upon that account, are often capable of combining together the powers of the most distant and dissimilar objects.*38 In the progress of society, philosophy or speculation becomes, like every other employment, the principal or sole trade and occupation of a particular class of citizens. Like every other employment too, it is subdivided into a great number of different branches, each of which affords occupation to a peculiar tribe or class of philosophers; and this subdivision of employment in philosophy, as well as in every other business, improves dexterity, and saves time. Each individual becomes more expert in his own peculiar branch, more work is done upon the whole, and the quantity of science is considerably increased by it.

Adam Smith’s major contribution was to link the evolving and increasingly more developed division of labour to the creation of wealth.

Friedrich List on the need for the state to build innovation systems

While Adam Smith was propagating free trade and a liberal economy the German economist Friedrich List disagreed. He characterised Adam Smith’s theory as ‘cosmopolitan’ and argued that if followed by other countries, it would just confirm and reinforce the dominance of the British empire in the world economy.
He argued that for countries such as Germany that wanted to ‘catch-up’ with the leading economy there was a need for government intervention. List is mainly known for his argument that it might be rational for late-comer economies to protect ‘infant industries’ until they grow up and become strong. But he presented a much broader agenda aiming at engaging government in the building of infrastructure that could contribute to technical advance. It is interesting to note that he referred to ‘mental capital’ as the most important kind of capital.

Actually, it might be argued that the current popular concept of national innovation system was immanent in his writing on national systems of production.

*Karl Marx on technological progress*

The historical parts of das Kapital give deep insights in how new technologies shape the economy and society. The basic assumption in his historical analysis that new productive forces may get into conflict with ‘production relations’ is also a useful guideline for studying innovation. At the micro-level this corresponds to the fact that radically new technologies can not flourish in the established institutional and organisational framework.

Marx also is a pioneer when it comes to emphasize the importance of ‘technological competition’ where firms need to engage in innovation in order to gain markets and reduce costs. Many of his insights on the role of science and technology in relation to the economy are very advance for his time (Rosenberg 1976)

Some of the analytical parts of das Kapital are not so different from what you find in standard textbooks when it comes to innovation. Here the focus is mainly on process innovation and Marx operates with a kind of aggregate production function model. Karl Marx was interested in the future of capitalism and he saw one very important limitation for the system in the falling rate of profit. The law on the falling rate of profit was not well formulated, however. It neglects product innovations and implicitly it assumes that the rate of process innovation is lower in the sector producing the means of production than it is in the sector producing means of consumption.  

---

7 I have argued elsewhere that Marx got ‘locked in’ by his ambition to become ‘a real and recognised economist’ rather than let the problems he wanted to analyse steer his studies. His theoretical focus on the average rate of profit and relative neglect of uneven development undermines his work on understanding the dynamics of the economy. It is also interesting to note that Marx’s unsolved transformation problem has its counterpart in the inconsistencies in capital theory as they are reflected in the re-switching debate.
Joseph Schumpeter as the grandfather of modern innovation

Joseph Schumpeter is generally seen as the founder of modern innovation research and many scholars who work on innovation would accept to be classified as Neo-Schumpeterian. Schumpeter was very much impressed by the work of Karl Marx and perhaps it is justifiable to say that he had the ambition to become ‘the Marx of the Bourgeoisie’. Schumpeter in his historical studies took a special interest in major technical innovations and new technological systems such as the railways. He had the ambition to link to each other major waves of technological change and long waves in economic development. He also shared with Karl Marx the interest in the long term viability of capitalism.

In *Theory of economic development* (Schumpeter 1934) innovation is seen as the major mechanism behind economic dynamics. Schumpeter goes as far as to argue that ‘without innovation no capitalism’. He sees the innovation as the only sustainable source of profits and growth. The basic mechanism is that individual entrepreneurs who are seen as rule-breakers and forerunners introduce innovations – as new combinations - in new firms and markets. They do so by lending money from financial institutions. This gives rise to profits for the pioneers. After the pioneers follow imitators who also want to have their share in the profit and at some time the profits created by the original wave of innovation are eroded. Growth slows down until entrepreneurs introduce a new innovation wave.

In *Capitalism, Socialism and Democracy* (Schumpeter 1962) his innovation mechanism is quite different. Here the major source of innovation is not the brave individual entrepreneur but the big company with experts working in R&D-teams searching for new technological solutions. The money needed for innovation are created within the corporation. The distinction between the two ways to present the motor of innovation has led scholars to refer to *Schumpeter Mark I* and *Schumpeter Mark II*. It has also led to a debate on the role of market power and innovation. Is it the small firm exposed to strong competition that is the most important source or is it the big monopolistic firms? Sometimes the second position is presented as ‘the Schumpeterian Hypothesis’.  

---

8 The main outcome of the many attempts to analyse competition and innovation is that innovativeness may be growing with size but at some point it decreases with size – there is an inverted U-form between size and innovative
Another major debate in innovation theory that emanates from Schumpeter’s work is about what role should be ascribed to respectively the supply side and the demand side when it comes to explain innovation. Schumpeter took a somewhat extreme position by assuming that the demand side would always adjust to the supply side. Consumers and users were assumed to absorb whatever new innovations were brought to them by entrepreneurs or firms. This was challenged by Schmookler (1966) challenged this view and demonstrated that innovations tend to flourish in areas where demand is growing.

Again the debate has been intense and one important outcome has been a new perspective on innovation as reflecting interplay between supply push and demand pull. The critical debate of Schmookler’s empirical results confirmed this new perspective (Mowery and Rosenberg 1977). The Chain-Linked model where there is both supply push and a demand pull in relation to scientific knowledge may be seen as one contribution to the new perspective (Kline and Rosenberg 1986). The perspective on innovation as a process of interaction between producers and users may be seen as a micro-dimension of this new perspective (Lundvall 1985).

**Christopher Freeman as the father of modern innovation theory**

Christopher Freeman played a key role in stimulating these new theoretical developments, especially in Europe. In the early eighties many of the lectures he gave to Ph.D.-students were on Schumpeter Mark I and Mark II or on the controversy between Schumpeter and Schmookler regarding the role of supply and demand in the innovation process. Also his founding of Science Policy Research Unit (SPRU) at Sussex University 1966 was a major step toward giving innovation studies a more permanent institutional foundation. Most of the active innovation scholars in Europe and in Latin America have spent time studying and working at SPRU.

---

9 In the US Richard R. Nelson and Nathan Rosenberg played the most important role in developing the theoretical, historical and empirical understanding of innovation.

10 Me and my colleagues in the IKE-group had the privilege to have him as guest professor at Aalborg University for periods and there is little doubt that we all became his apprentices. He is not only an outstanding scholar but also a uniquely generous person.
One of the important references in his lectures in the beginning of the eighties was to the *Sappho-study* organised at SPRU (Rothwell 1972 and Rothwell 1977). This study was simple but original in its design. The research team located a number of innovation pairs – ‘twins’ in terms of major characteristics - where one of the two was a success while the other was a failure. The two innovations were then compared in terms of organisational and other characteristics. The most important result was that interaction within and between organisations came out as one of the prerequisites for success in innovation. Firms where divisions within a firm operated without interaction were less successful and firms that did not interact with suppliers, users and customers were also less successful. Freeman pioneered the vision that innovation should be understood as an interactive process not as a linear one where innovation automatically came out of R&D-efforts.

Freeman was also the pioneer when it came to introduce the concept of ‘national system of innovation’. He did so 1982 in a written contribution to an expert group on Science, Technology and Competitiveness. In this paper he referred to the work of Friedrich List and argued that countries that are in a catching-up processes need to build institutions to support innovation and without such efforts free trade might have a negative impact on less developed countries. He starts from List’s criticism of Adam Smith but shows that the most important contribution by List was not his protectionist proposals but rather the emphasis on governmental initiatives to build ‘infrastructure’ and invest in ‘mental capital’ (Freeman 1982/2004).

*The flourishing eighties*

The eighties was a period where innovation research became ‘emancipated’ and more ambitious also in terms of confronting standard economics. Important work took place in different areas both in Europe and in the US. Dosi, Pavitt and Soete made important contributions to the role of innovation in relation to foreign trade. Christopher Freeman and Soete analysed employment issues in relation to technical innovation. Giovanni Dosi established his hypothesis on shifts in technological paradigms.

In the US the Nelson and Winter evolutionary economic approach to economic growth signalled a much more ambitious agenda for innovation research (Nelson and Winter 1982). Rosenberg and Kline presented the Chain-linked model. Freeman and Lundvall developed further ideas about innovation as an interactive process and innovation systems together with Richard Nelson.

These different efforts went together in two different major projects. One was a major book project led by a team consisting of Dosi, Freeman, Nelson, Silverberg and Soete. This book came out in
1988 and was important in bringing together in one volume the state of the art work in different sub-fields of innovation studies. Also, the book as one of the first made it clear that innovation theory presented a challenge to how technical change was treated in models of standard economics.

The other major project took place in the policy realm and it was organised by the Directorate for Science Technology and Industry at OECD. The TEP-project was initiated by Director Chabbal and intellectually it was kept together of the French scholar Francois Chesnais. A series of conferences were organised where innovation scholars met with general economists and policy makers. These conferences opened up a new understanding of innovation and how it might matter for policy-making. The TEP-report integrated many of the most advanced ideas developed among innovation scholars in the eighties and it gave innovation policy as well as innovation studies a new kind of legitimacy in all OECD-countries. The idea that innovation is an interactive process and that it is useful to define national innovation systems became spread to policy makers in different parts of the world through the TEP-project,

Where does innovation research stand today?

Innovation research is a growing field. Fagerberg (2005F) shows how social scientists and economists increasingly engage in research on innovation. Important new insights in how innovation takes place have been produced and public policy and management strategies are increasingly built upon these insights.

Important next steps for innovation research are:

1. To develop a deeper understanding of knowledge and learning in relation to innovation.
2. To link individual entrepreneurship and individual creativity to collective entrepreneurship and organizational creativity.
3. To develop more reliable indicators and measurements of some of the soft sides of the innovation system – such as organizational forms, networks and social capital.
4. To work out more systematically the implications for standard economic theory of the insights gained from innovation research.
5. To link the analysis of innovation systems more strongly to economic development and to the needs of less developed countries.
Other specific areas calling for more research have to do with innovation in services, innovation in low-tech sectors and the role of finance in the innovation process.

It was only recently that innovation became recognised as a major source of economic growth among economists and still many belonging to the profession have problems with grasping the importance. This has to do with the fact that theories and tools used in standard economics are not well suited to capture the basic mechanisms in the innovation process. Especially problematic is the neglect of ‘learning as competence-building’. In an economy where the capability to build new competence is the key to economic success it is a serious weakness of a theory to assume that all agents are identical (as assumed when the starting point is ‘the representative firm’). Our course may be seen as an attempt both to diagnose and to overcome this weakness. We will analyse the innovation process as joint production producing both new ideas and new skills and competences.

References:

Christensen, J.L. and Lundvall, B.-Å. (eds.) (2004), Product Innovation, Interactive Learning and Economic Performance, Amsterdam, Elsevier


