PILOT
NEWSLETTER

- 4 -

The PILOT project is funded within the European Commission's Key Action Improving the Socio-economic Knowledge Base.

Editorial

Dear readers,

With this 4th volume of the PILOT-NEWSletter we want to inform you about some of the “dissemination activities” undertaken by members of the PILOT team during the second project year and present preliminary results of our research.

Francesco Garibaldo of Istituto per il Lavoro (IpL), Bologna represented our project at the annual conference of the European SME association UEAPME in Luxembourg. You find the speech he gave there below.

Next is a report of the Spanish PILOT team – Holm Köhler and Hans van den Broek – on a conference organised in Oviedo together with the Asturian Innovation Club.

Finally Andrea Bardi of IpL gives an account of a Workshop the Bologna team organised for members of the Italian national reference group.

The other contributions to this newsletter come from the North.

Staffan Laestadius of the Royal Institute of Technology Stockholm discusses difficulties of conventional S&T based taxonomies of industries and of innovation and introduces ideas for a more appropriate approach.

And last but not least, Trond Pedersen of NIFU-STEP in Oslo presents results of the statistical analysis of data from a selection of OECD countries.

We would like to thank the authors very much for their contributions and we hope that you will enjoy reading them.

And on behalf of the whole PILOT team we wish you all the best for the New Year,

Katrin Hahn & Gerd Bender

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Content

Innovation in small and medium sized enterprises – not only "high-tech"

Francesco Garibaldo

The following speech was given by Francesco Garibaldo at the session *Innovation in SMEs – not only "high-tech"* of the 3rd Craft, Trade and SME Summit "EU – Enlargement SMEs meet the challenge" in Luxembourg on 23-24 April 2004.[1]

Ladies and Gentlemen,

First of all, I would like to thank the organisers for kindly inviting me to such an important conference. As you probably know, I am a member of an EU-funded research group whose aim it is to explore new avenues for policies supporting innovation in the low-tech industries in Europe – the precise goal is to support Knowledge Formation, Employment & Growth Contributions of the 'Old Economy' Industries in Europe (PILOT). Right now my colleagues are in Vienna discussing the preliminary results of our case studies in Europe, to be more precise in 5 sectors. I am here to illustrate some facts and ideas for you accruing from our project as far as it has been developed it.

A change in paradigm

The adjective "low-tech" does not, from our point of view, have a negative connotation for some enterprises as opposed to the high-tech industries that should, by definition, be the cutting edge as well as the future. Quite the contrary: we are actually casting some doubts over this biased view. What I mean is that we do not oppose the need for high-tech industries to develop in Europe, but that we consider the "old industries", namely the manufacturing sector, to be strategic today as well and part of a complex, integrated industrial policy for Europe.

Let me explain and argue out this statement. Being a high-tech or a low-tech company is not akin to being tall and slim, or short and fat for that matter; it is merely conventional definition coming from a classification sponsored by the OECD and implemented through a handbook defining parameters and indicators for the classification of industries; the main indicator is the collection of R&D data. Accordingly, an industry should be classified as low when it is spending less than 0.9 percent of its turnover on R&D, medium-low between 0.9 percent and 3 percent, medium-high between 3 percent and 5 percent, and high when spending more than 5 percent of its turnover in R&D. So to stress this indicator instead of other possible indicators, for instance, the contribution to GDP, the contribution to employment levels, the stability of performance in the mid-term, the contribution to giving employment opportunities also to unskilled and semi-

[1] The Craft, Trade and SME Summits are organised by UEAPME, the European Association of Craft Small and Medium-sized Enterprises.

skilled workers and therefore to social stability, etc, is a choice that stems from mainstream economic and policy thinking, based on the paramount importance of knowledge-intensive and science-based development.

As a researcher from our group has summed up quite clearly:

In the field of research and technology policy, the debate as to how to support growth and employment in Germany as well as in Europe is founded, in exaggerated terms, on three inter-related premises:

- *firstly, the level of wealth in countries like Germany, can only, in the long run, be maintained by the increased development of high-technology and high-quality products, since this is supposed to be the way to achieve a real competitive advantage and thus to fetch high prices;*
- *secondly, high-technology products, particularly ICT products are preconditions for innovative products in other sectors, having an important cross-sectoral function;*
- *thirdly, in view of the local political and institutional circumstances, the feasibility of a strategy based on the price and cost reduction of given products is restricted.* (Hirsch-Kreinsen et al., 2003).

As I have already said, we are not questioning the importance of these industries, namely Information and Communication Technologies Industries (ICT) and the Biotechnology Industries (BTI): our point is that a broader picture of economic reality must be taken into consideration.

First of all, for the time being, the role of “old industries”, not only in Europe, in maintaining a socially and economically sustainable level of Gross Domestic Product and employment, lacks any real alternative. Depending on each country or different world economic region, data change but they are still very clear: without those kinds of industries our societies would be facing a tough economic and social crisis.

Secondly, the industrial and economic structure of our countries and Europe as a whole is made up of a complex web of networks, districts, clusters and *filières*. The interplay among the different participants of these economic and social structures cannot be ranked as important, less important, that can be discarded. The reason is that the contemporary industrial structure, because of its quest for flexibility, is based on the co-operation/integration among many different firms, so the overall outcome of this industrial co-operation/integration depends on the capabilities and competencies of each network node. Some of these capabilities and competencies are not science-based but are nevertheless critical to the success of the industrial process. But why are these capabilities and competencies critical? Of what kind are they?

In order to provide an answer to the last question a short digression is necessary. Another part of the mainstream thinking is that innovation is a linear and step-by-step process: first comes the science that makes discoveries, then applied science comes and designs technology; later, technology translates knowledge into devices and artefacts and eventually the industrial process comes along. Within the industrial process the same kind of linear process can be expected: a first-rank industry designing concepts and procedures, then less important industries simply implementing it, according to clear-cut and exhaustive instructions. Lastly, the customer will buy the technology embedded in a specific product or service. This narrative of the innovation process is totally unrealistic. The push-scheme of technology, as a rule, didn't work in the past and won't work in the future; take the fax machine whose technology was available over a century ago whereas no one used it for years afterwards, or let's take the case of the mobile phone or the TV: both were designed for totally different kinds of use and the development path did not follow the one envisaged and designed by the technologists. So innovation, I mean real innovation, not the potential one, depends on the actions and capabilities and competencies of each node of the production network and at times also on a combination of a totally unpredictable demands from customers, and the innovative utilisation pattern of some firms. So innovation not only stems from the R&D lab but from the capabilities and competencies of using the science and technology already existing; this kind of innovation capability is grounded in different possible kinds of knowledge, very different from the formalised knowledge of science and technology, and in the social intercourse by different firms within a network, or a cluster, a district, a *filière*. There are many different possibilities: from tacit knowledge, based on a steady accumulation of practices over a long time-span in a specific sector of activity or branch of industry, to practical knowledge, consisting in a proper and optimised utilisation of the potential of a specific organisational scheme, etc.. I am now talking not only of product innovation, which is of course the main driver of successful innovation today, but of organisational innovation; a very specific mode of organisational innovation. I mean the capacity and the competence of organising a complex system of co-operation/integration among different actors in order to make it possible, also in low-tech industries, that are exposed to fierce competition from the emerging economies, to afford a viable and sustainable business model. These two kinds of innovation: organisational and product innovation are actually strongly interwoven, as our sample indicates.

A fourth argument is the possibility to utilise an existing technology as a result of a specific innovation capacity that has been defined in the literature as "architectural innovation" (Henderson, Clark 1990; Bender, 2005), in other words, a reconfiguring of existing components. This kind of competence appears to exist and operate in some of the firms in our sample (Bender, 2005). This kind of knowledge is a specific capability and competence depending on a long process of sedimentation of practices and experiences in a specific business area, and it is embedded in a specific organisation. This kind of knowledge utilises the scientific and technological knowledge available; however, it is not simply implementing it but is reshaping it.

A fifth argument concerns ICT and BIT themselves. ICT and BIT are the same time a sector of industrial activity and horizontal technology, like the steam engine in the first industrial revolution; this is self-evident in the case of ICT but it is true also for BIT. I mean that what is relevant today as a strategic issue for the EU is not to just abandon the old industries for the new ones, considered to be the paradigm of a knowledge society, but to utilise them both as horizontal technologies capable of aiding the dramatic process of product and organisational innovation in the old industries so as to allow it to maintain competitive momentum. To illustrate my point, I would like to back it up with a few arguments.

ICT is, first of all, a powerful communication and organisational technology that can enhance, for instance, the opportunities and capability of co-operation and integration of different actors in the industrial process in order to improve productivity and flexibility, but also to fully utilise the existing architectural and tacit knowledge, along the industrial chain, for developing product innovation. ICT is also a technology that can be applied to develop, and not to innovate, products as is occurring everywhere in the industries. A proper utilisation of ICT as an organisational and communication technology will imply a deep process of change in how a business is organised and managed as well as how people are committed. Each case is different and there are no all-embracing solutions and models but there is a general, internationally available knowledge that can be used as “a toolbox” for designing specific solutions. It is a matter of organisational, managerial and Industrial Relations innovation. A good case in point is the bilateral process of innovation between science-based industries and the others. ICT design as a communicational and organisational technology can be very successfully shaped by including the end-users as co-researchers.

BIT can be used, and there are already people working on this, to design brand new materials for the clothing and textiles industries. In this case the issue of technological-transfer seems critical.

Another argument concerns the widening gap, in some industrial sectors, between society’s needs and demands, what economists call the “utility value”, and the exchange value of a good. What is striking is the fact that a poor supply coincides with elements of excess productive capacity in entire sectors of goods production that are by now structural – for example, the motor car - and that huge amounts of capital, socially-produced wealth, is spent on colossal mergers – for example, in the car manufacturing and telecommunications sectors – whose only purpose is to make even more redundant, for the competitor that is, the existing productive capacities with a view to living off its disappearance. This enormous capital is invested without adding anything to existing wealth, while actually destroying a part of it or not supplying any new capital where it is needed.

In the car industry alone excess capacity can be as much as 30 percent. So what? Some SMEs, for instance in my region in Italy, are now supplying goods to satisfy these needs and to shrink the gap, for instance by producing zero-emission vehicles and they are becoming prosperous as a result. So another source of innovation, which requires science but whose core capability and competence is not science, is to prospect society, as a potential field of unaccomplished industrial activities, based on traditional knowledge of old industries but fashioned in a totally different direction. This implies new business models, different ways of organising the industrial chain and, most of all, an entirely new kind of relationship with the Universities. In 1997 in Sweden a third task was handed to the Universities and the higher education and research centres: to relate to and collaborate with practitioners in the community close to the university to support development processes. This is not merely a question of technology transfer but a co-operative research scheme to face, with the research potential of the Universities and similar bodies, societal needs and demands by designing actual solutions that real people can develop.

New Policies

From our standpoint, with this change in paradigm new policies are needed for the SMEs and the craft businesses.

First of all, old industries need to be reappraised as a source of innovation combined with economic and social stability; this implies a distinction between knowledge- and science-based. Europe can try to become a knowledge-based society also including in the definition of knowledge different kinds of knowledge, because all kinds of knowledge are interwoven and to discard some of them will lead to weakening the others. In this hypothesis also public funding and incentives should be reconsidered to support network-based kinds of innovation taking advantage of the R&D capability as a collective resource of the network or the society where they are located. Public funding should be redesigned to support mid-term collective projects of change, according to the clear objectives and standards that are to be accomplished.

Secondly, a quantum leap should be organised in the availability of a skilled labour force in Europe, not skilful in the sense of being congruent with science-based industries alone, but to acquire the capacity to become active in storing practical knowledge as a part of his/her own vocational skills. This implies a European-wide scheme of development and the certification of skills, that do not just accrue from a formal educational course, as a personal asset. The existence of social capabilities should be included in the assessment of a person's professional skills.

Thirdly, many different forms of intermediate institution lying between science and the SMEs should be considered in order to make publicly available knowledge on organisational building, ICT utilisation possibilities, managerial techniques, education schemes especially to engender team capabilities, network governance methodologies and techniques, Industrial Relations opportunities, etc.. This kind of knowledge should not be made available in the form of cookbook recipes and the like but as active form of development between networks of firms, intermediate agencies and the main stakeholders, according to already existing experiences in Europe, based on action research schemes.

Fourthly, universities and similar bodies should add on new functions inspired by the third task of the Swedish reform.

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Successful PILOT national reference group meeting in Oviedo (Spain)

Hans Peter van den Broek and Holm-Detlev Koehler

On July 8, 2004, the Spanish partners of the PILOT Consortium, in association with the Innovation Club of Asturias, organized a conference on "Innovation and Knowledge Management in Enterprises in Traditional Sectors", with the objectives of informing regional businessmen, politicians and scientists about the provisional results of the PILOT Project and debating with them some central questions of innovation and knowledge management in low-tech industries.

The conference was attended by over 50 people and received regional television and newspaper coverage both on the days before and after the event.

It was the second Spanish PILOT National Reference Group meeting which differed from the first for its more open and widespread character.

Holm Koehler, Director of the Spanish programme, introduced the objectives, background, main topics and provisional conclusions of the PILOT research in a speech titled "Innovation Strategies in Traditional Firms – case studies in Asturian and foreign companies". Next, Keith Smith, member of the PILOT Consortium and presently working at the (EC Joint Research Committee) Institute for Prospective Technology in Seville, Spain, held a conference on "Innovation and Growth in Low-Technology Industries", highlighting the differentiation between innovation based on *Science and Technology* (S&T mode) and what he defined as a *DUI* mode of innovation, resting on learning by *doing* and *using*, and problem-solving by *interacting*. While current understanding of the Knowledge Economy tends to focus on the (high-tech) S&T mode, it is being largely ignored that (low-tech) manufacturing and service industries have a much greater impact on Gross National Product and employment; that they are no less innovative and knowledge intensive; and that they are often growing. Smith argued that innovation in 'mature' industries is characterized by inputs that demand low direct R&D performance – such as market research, training, product design, etc. – but, conversely, by intensive use of indirect R&D (through inter-sectoral knowledge flows form high-tech to low-tech). He stressed the need for better information on knowledge bases, innovation processes and market evolution in actual and emerging industries.

Subsequently, three business people gave presentations on how innovation was being managed in and by their companies: a milk producing firm, a forest products company, and a management and ICT consultancy specializing in working with low-tech firms. A round of questions revealed the desire of the audience to learn more about the link between innovation and Human Resources and the role of internal and external training in knowledge accumulation. More detailed information was also demanded on innovation in service sectors.

The conference ended with concluding observations by the organizers and people from local and regional government. There was a very positive response to the PILOT message.

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National reference group report Reggio Emilia (Italy)

Andrea Bardi

Premise

The Institute for Labour Foundation (IpL), Bologna organised a meeting of the Italian National Reference Group (NRG) of the PILOT project in late October 2004. The meeting was held in the province of Reggio Emilia, one of the Emilia Romagna region's most important manufacturing bases.

Along with the members of the NRG, important local actors like the trade unions CGIL and CISL, employer associations (CNA, API and GIR) and industrial companies, participated in a discussion group. The group analysed the key dynamics driving the transformation of the local productive structure, and touched on many themes relevant to the PILOT research project. It's important to mention that, while the discussion focused on industry in the province of Reggio Emilia, what emerged was a picture that corresponds largely to the regional dynamics at play in the whole Emilia Romagna.

Discussion was set up by IpL describing the relevant PILOT topics, asking the participants in which way these elements are relevant for the local productive system and its development.

Main trends

All of the participants were in agreement that Reggio Emilia's productive structure is in a phase of prolonged transition. While in the past the capacity of the industrial district to emulate and imitate competitors represented a competitive advantage, this capacity no longer represents a model of sustainable growth for the local economy. On the other hand the industrial districts' traditionally high degree of social cohesion is still of strategic importance, especially given the rapid process of transformation underway.

The relationship between advanced services and manufacturing

Recently much of public policy has been focused on providing support for the growth of the advanced service sector. While the continued growth of the service economy is important to overall economic growth, public policy cannot loose site of what is at the core of Reggio's economy: manufacturing. Participants stressed, therefore, the need for a dialectical approach to policy that sees services and manufacturing as complementary elements of economic growth.

Still, there are very real and profound changes happening inside the traditional manufacturing sectors. One of Reggio's core sectors, agricultural equipment, gave birth to hydraulics manufacturing. Thanks to hydraulics, agricultural equipment became more productive, actually contributing to the weakening of the agricultural equipment sector and the strengthening of hydraulics. Other changes occurring include the “erosion” of the engineering industry as steel is now being substituted by carbon fibres and titanium- and resin-based alloys.

Global competition and the industrial district

One of the most significant dynamics at play in the traditional industrial districts is the stretching out of the productive *filière* as they become enmeshed with different sectors. This dynamic makes the sectoral-based analysis less effective. Alongside this development is the geographical expansion of the districts, with even important suppliers coming from outside of the region. The result of these rapid changes is that the districts are no longer self-sufficient entities.

In addition to the enlargement of the *filière*, manufacturing in Reggio has witnessed an increasingly rapid shift of production towards the East, in particular to China. In this case delocalisation and global procurement (internationalisation of the supply chain) represent winning strategies, in particular when dealing with low-tech products. Still, not all of the province's industries, like rubber & plastics and ceramics, are affected equally.

Particularly relevant to PILOT is the fact that delocalisation is not always driven by cost considerations. Often companies look outside of the territory for know-how and capacities not found in the company's home territory. One example of this type of outsourcing, driven by a lack of in district knowledge, is the case of the company that turned to an Austrian research centre to develop a next generation motor. And, while the quality of foreign products is often inferior, there are examples of companies who choose foreign suppliers over local ones because of superior quality, as in the case of an important producer of motorcycles in Bologna that chose a Japanese supplier because of the low-quality of the local supplier's components. While in many cases delocalisation and global procurement strategies are driven by cost considerations, the opposite is also true: local Original Equipment Manufacturers (OEM) are forced to look to extra-territorial suppliers because quality services and products are in short supply on the local market.

Finally, regarding outsourcing, there has also been an increase in final firms outsourcing to a greater extent within the district, especially when proximity between supplier and purchaser is important.

Globalisation has also had a significant impact on companies' marketing and sales strategies. If in the past districts relied on importers to effectively market and sell products abroad, today a more direct link between end producer and client is important. By directly taking on more marketing and sales companies increase the level of trust between buyer and seller, they increase the percentage of value added retained by the company, as well as the opportunity to react more quickly to shifts in demand.

Another force for change in Reggio Emilia's industrial districts is the acquisition of local firms by multinational corporations. These acquisitions are usually friendly, and the buyer's interests are frequently in maintaining the existing management and labour force. For these reasons, the multinational buyer often represents a positive force, contributing to the improvement and professional growth of the company's workforce and management.

Infrastructure

The discussion group also touched on the topic of infrastructure, which in Reggio Emilia is inadequate. For example, as long as high speed internet access is sparse and inconsistent, companies cannot take advantage of new information technologies. There is also a gap between the demand for larger plant dimensions and supply, which still favours the small company. Besides new constructions, existing sites, no longer in use, must also be upgraded to meet the needs of medium and large enterprises.

Innovation

Reggio Emilia's manufacturing base is characterised by a strong orientation towards process innovation. Though product innovation is present, it is often insufficient especially considering the changing technology frontier in some *filière*.

Many groups make their living off of brand recognition and outdated product innovations. The emphasis of local firms on process innovation means that investments are prevalently in new facilities, equipment and tools. This trend is only reinforced by the different certifications which tend to favour process optimisation over product innovation. Organizational innovation is particularly insufficient in the small and medium enterprises (SMEs). Despite the regional government’s attempts research remains the Achilles’ heal of local industry. Given that, besides price, competition is based primarily on product innovation, client services, logistics, internet and response time manufacturing risks finding itself at a competitive disadvantage.

The SMEs present pointed out that the decision of some of the larger companies to follow cost-cutting strategies to competitiveness risks damaging the small, local sub-suppliers. Competition from abroad, in particular China, and the fact that manufacturing in Reggio Emilia is made up of mature sectors most exposed to global competition, means that the local productive system needs to raise the “tone” of innovation.

Entrepreneurialism and the knowledge system

The local manufacturing system's key strategic resource is it's diffuse, deeply rooted high-level knowledge structure. This is a resource found both in the entrepreneurial class and on the labour market. On the other hand, the capacity to emulate, typical of the family owned company, is no longer enough.

One of the strong points that characterises the companies of Reggio Emilia, and that has allowed them to survive the ups and downs of the market, is the strong "industrial mentality" of their founders. The second generation of entrepreneurs, more managerial in mentality, tend to move their companies' core business toward services, and away from production, something that has accelerated the transformation of the local productive structure.

While functional flexibility is deeply rooted in the local economy, numerical flexibility is on the rise. Notwithstanding, the local fabric still seems capable of stabilising the local labour force. Flexibility based on the use of overtime and shifts, and multifunctional skills have proved to be strategic resources.

Workforce training represents a weak point for the local economy. Firms are overly dependent on public financing for training. The result is poor quality training, often incomplete or tailored too specifically. Continuous training is hardly present and, when it exists, tends to be concentrated on a few professional figures. Another limitation to workforce training is the fact that workers change jobs often. This seems to indicate that workforce training needs to be done more at the system level, rather than for the single firm.

In general, participants commented on the lack of "competitive tension," or "effervescence" in workers and companies. This translates into a lack of innovative behaviour. What's needed, then, are new incentive systems capable of stimulating creativity and innovation.

Research and university

Ties with the University are still weak, but this may be due to the fact that the Universities of Modena and Reggio Emilia have only been around for a few years, and building effective links between companies and academia is a long process. Still, an important step was taken by creating the degree in Management Engineering. This is an area in which SMEs are particularly weak. Another problem regards retention of qualified workers, and not just training. Many qualified workers, particularly those with a university degree, choose not to stay because of the poor quality of the work itself or of the working environment. This implies the need to work in parallel to improve both the workplace environment and the substance of the work done.

The enterprise system and the question of size

The small size and flexibility of SMEs in Reggio Emilia doesn't represent the strategic resource that they once did, since now even large multinationals have found ways of increasing flexibility and are capable of satisfying the needs of niche markets. In short, the "scissors" effect between winners and losers is becoming more accentuated.

Though recent years have seen an increase in the number of company groups, the capacity to build systems of companies is still very low. Too often, mergers and acquisitions are guided by financial considerations and not the desire to create synergies among different businesses.

The potential for productivity increases and innovations resulting from greater vertical collaboration among clients and suppliers is still significant. Unfortunately it is often the client's purchasing department that represents a barrier to greater integration.

It is also important to support processes of greater horizontal collaboration, or networking among enterprises, to provide integrated solutions, and not just single products. Greater integration among independent companies is needed in order to reduce the fragmentation of the productive system.

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WP1 – an integrative and theoretically focused part of the complex PILOT project

Staffan Laestadius

Introduction

Research in the PILOT project is done within six work packages (WP) which – although with different tasks – are highly integrated in each other (cf. PILOT Newsletter Vol. 1) All PILOT partners work in several of the packages. WP1 is the theoretical package and is supposed to work all over the PILOT period. The general objectives for the work package is to improve concepts and theories of knowledge formation in low-tech industrial and technological activities and to design a better approach to taxonomy and data acquisition for analysis, management and policy.

The context of WP1 work

The economic context: the manufacturing output within Europe is to more than 85 percent produced within industrial sectors labelled non high-tech. Including service sectors it may safely be assumed that less than 5 percent of economic activity is produced within high-tech sectors (somewhat depending how we classify service sectors). It has been so for years and will continue to be so for the near future, which can be shown with simple modelling exercises.

The political context: there is, in many European policy circles, still a strong belief that national policies to increase R&D-spending is an efficient means to favour economic growth and industrial transformation and thus also to decrease unemployment. The Lisbon decisions show a strong confidence that the European road to a knowledge society should go via spending 3 percent of GNP on research and development.

The empirical context: a few years into the new millennium it is more clear than ever that empirical data do not support the belief that R&D intensive firms or industries contribute more to solving the growth and employment problems than do non-high-tech firms or industries. Many firms – and industries – with low R&D intensity survive with reasonable growth and profitability for decades (like the pulp and paper industry) or grow fast due to other capabilities than those normally labelled R&D or innovations. Swedish IKEA and H&M are good examples on that. Also for many service firms, from Ryanair to design consultants much of the R&D focus is irrelevant in their growth strategies.

The global context: people working within maturing industries are all aware of the strong competition from foreign firms. For Europeans nowadays much of the competition comes from firms in Asia. The conventional wisdom – strongly supported by international trade theory – is to upgrade industrial activity to more knowledge intensity assuming that Europe has a relative advantage in knowledge intensive production compared to labour intensive. So is probably also the case. One problem, however, is what kind of knowledge and capabilities do favour European industrial production? Another is that also Asian firms face strong competition from other Asian firms forcing them to upgrade to higher knowledge intensity.

The analytical context: Innovation researchers have during a long time analysed the mechanisms of industrial and technical change. Much of the work has been done at institutions within the OECD and EU. Over the years the innovation concept – originally coined by the Austrian economist Joseph Schumpeter and explicitly not related to science or inventions – got a strong relation to "science & technology" (with a special political history during the cold war) and surfing on the ICT-revolution during the last decades of the passed century. The Community Innovation Surveys (CIS) performed since the nineties has been one means to get out of the emerging irrelevance of a too narrowly defined innovation concept. But the typologies developed during the 1980s (with origin within the OECD) focusing on technology level (interpreted as R&D intensity) has shown a strong survival capacity in spite of the many disappointed voices among academics.

The low-tech context: in short, the technology indicators – classifying manufacturing industries as high-tech, low-tech or somewhere in between – is in the focus of the criticism. Its relevance is now challenged. More important however is that they influence policy as well as management decisions. On the eve to the knowledge based society, we in fact seem to have weak ground to evaluate firm capabilities and knowledge formation process outside the R&D domain. The risk we run with using the blunt tools in the present transformation of industries to a stronger knowledge base is throwing out the child with the bath water.

This is the context for the PILOT project as a whole but especially for the work package 1 which is supposed to navigate in this world of concepts and to suggest alternatives.

WP1: a work package for theoretical reflection

The *questioning of the narrowly defined science & technology related innovation concept* is an important aspect of WP1 tasks. In short, several of the contributions to the work package focus on the fact that parts of the "low-tech problem" depend on a too narrow definition of industrial and technical creativity. In addition, this may partly be the result of an understanding of innovations too much related to the second industrial revolution (with its division of labour between intellectual and manual work) and the rise of manufacturing industry and partly to the – in reality – still strong position of what is often called the linear model (roughly assuming a linear dependence from basic science to consumer products.

The theoretical work within WP1 as well as the results from the case studies in WP3 (cf. Schmierl & Kämpf in PILOT Newsletter Vol. 2) reveal that *successful low-tech firms often owe their successes* *to capabilities in design and logistics. Other firms seems to be highly capable to integrate technologies from different knowledge areas.* There seems to be no – or few – indications on a low-tech specific mode of knowledge formation. Rather does our work support (our case studies do not "prove") the position that profit enhancing capabilities occur all over the technology spectrum; from "low-tech" to "high-tech" and that the capabilities behind may differ a lot.

To broaden our analysis of why firms classified as low-tech succeed and how they do it we use *a further developed version of the capability concept* introduced by Teece & Pisano (1994) as a variety of the resource based theory of the firm. In short firm capabilities, making them profitable, may be defined in a broader way than to include innovations only; the later which contribute to a subset only of what we may include in the capability domain.

Our approach is fully in line with other attempts to develop *a more comprehensive typology on knowledge formation related to innovation*. In the typology by Faulkner (1994) as well as in the Kline-Rosenberg approach (1986) is the role of design important. That concept opens for much of intentionality and creativity of importance for successful firms and not normally accounted for as innovations. As regards the integrative capabilities discussed in the PILOT project they are in line with the discourse on the new production of knowledge (cf. Gibbons et al, 1994).

In short, not only is the "content" of the (traditional) innovation concept questioned within the WP1. The PILOT project also actualizes the importance of *the systemic character of industrial activity and thus where to locate the creativity of importance for profitability*. One aspect of this is the role of outsourced design and engineering activities for low-tech classified firms. The *role of knowledge intensive services* (the output of which not always is classified as innovations) *for industrial systems* to where low-tech firms belong is probably underestimated in dominant data acquisition on industrial creativity.

Towards a new typology?

The present work within WP1 and WP2 (see Trond Pedersen below) as regards a new typology/taxonomy – partly in line with the Faulkner typology but also influenced by Baldwin & Gellatly (1999) – preliminary indicates *a five dimensional indicator system* which – taken as a whole – will capture most important dimensions of industrial success in a knowledge society. In short, the roles and definitions of "R&D" and of "innovations" are different and only a subset of several indicators.

To become legitimate, typologies/taxonomies (let us use these terms synonymously here) have to fulfil a set of criteria of which we can mention simplicity, reliability, relevance and adaptability. The work in WP1 has to face that if we will have any chance to succeed.

Reforming the old technology level system with a more nuanced view on knowledge formation and capabilities in industrial and technical activity will probably have *implications on the present definitions in the Frascati Manual and the Oslo Manual* (the OECD documents which govern data acquisition in this area) as regards the “D” in “R&D” and as regards the concept of “innovation”. It will also impact on how future CISs are performed.

Although indicators – like the modified system which may be the result of the PILOT project – may reveal differences between industries (as normally classified) there are strong indications that the variety within industries is of a magnitude that general industrial conclusions should be avoided.

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Summary of results from work package 2

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Work package 2 (WP2) in the PILOT project concentrates on quantitative documentation and statistics that feed into the main arguments of the project. The main arguments are:

We contend that the growing knowledge intensity of economic and social development in Europe is not only based on industries with frontline technological knowledge. It is also highly dependent on so called low- and medium-tech industries. These are not necessarily low-growth industries; many companies and branches within these industries are growing fast, are interlinked with high-tech and service branches and provide an important platform for growth and employment in the future.

The quantitative data that are used to investigate the main argument can roughly be split into three categories:

1. Basic statistics on economic performance, employment, and other basic variables (typically OECD Structural Analysis database – STAN)
2. Survey based data on R&D, innovation, and other innovation relevant variables (typically the Community Innovation Survey – CIS)
3. Register data on formal knowledge and competence. (Typically individualised records of persons' formal education and current occupation, mainly available in the Scandinavian countries)

Concrete results

On the one hand the current work within WP2 is related to the mentioned documentation of the significance of so-called low and medium-tech industries in industrial production and for growth and employment. On the other hand we are concerned with empirical (statistical) dimensions that relate to the theoretically and conceptually oriented WP1. The work is currently focusing on issues of industrial classifications and taxonomies. Let us look at these two parts of our work in more detail.

Low and medium tech dominate production, growth and employment

We started off with the widespread argument that high-tech industries in some sense drive growth processes: it is claimed that they are the sources of growth in output, employment and productivity in the knowledge economy. This is a special case of a more general argument to the effect that economic growth is characterized by the creation of new and the replacement of old industries. ICT sectors are often suggested to be the most important examples of this enhanced role of high-tech. By contrast, it is argued that low-tech industries have declining shares of output for two reasons: their growth is lower (or they are declining absolutely) and they are relocating to low wage economies. That is, they exhibit trade-driven 'hollowing out'. If true, these claims would imply that shares of high-tech output are rising in growing economies, while low-tech shares are falling, and that countries with larger high-tech sectors would exhibit higher growth rates. We are examining such claims, and related hypotheses in the paper *Structural change, growth and innovation: the roles of medium and low tech industries, 1980-2000*, written by Sandven, Smith and Kaloudis.

In the paper the hypotheses are explored using OECD manufacturing and trade data for the twenty-year period between 1980 and 1999. Let us look at a couple of examples of the documentation we have come up with. As the graphs below (see annex) show, the economic structures as a whole have changed. Table 1 (p. 22) and Figure 1 (p. 21) show that the share of employment accounted for by all manufacturing sectors has declined. This is particularly reflecting the growth of financial services and social and community services.

Although structural change in manufacturing has occurred, the changes have been rather small, as we observe in Figure 2 (p. 23). The structural change in manufacturing, low-tech slightly down, high-tech slightly up and medium tech stable, does not account for the manufacturing growth that has occurred. Table 2 (p. 22) examines the four manufacturing sectors contribution to growth between 1981 and 1998. Although high-tech has been growing extremely fast, the growth is from a very low starting point. The medium high-tech sector grows about equal to manufacturing as a whole, while medium low and low-tech sectors grow below manufacturing as a whole.

Moreover, in the paper we show that there is considerable variation in manufacturing structures across OECD economies, and argue that structural diversity would diminish over time if growth was high-tech driven. This does not occur – comparative structures persist over time, and growth performance across countries is not correlated with shares of high-tech in manufacturing. The slowness of structural change means that low-tech and medium low-tech sectors *remain by a wide margin the largest components of manufacturing output and employment in OECD economies.*

Further on, we examine trade patterns for low and medium low-tech sectors, and (as showed in Figures 3 (p. 24) and 4 (p. 25) we find that changing domestic demand of low-tech manufactures has largely been met by changing domestic production; there has been some widening of trade deficits, but this has been small.

In the countries examined there has been a clear tendency for the share of low-tech industries in manufacturing to decline during the period 1980-1999, while the share of high-tech industries has increased. This applies to both production (whether value added or gross production) and employment. However, these changes do not appear to be dramatic. We conclude that among the OECD countries studied here, structural change within manufacturing is not a key feature of the growth process. However there has been structural change at the level of the economy as a whole, with a sustained rise in the share of services (both public and private). Of course this change does not support the structural change view of growth, since services tend to be considerably less R&D intensive than manufacturing. Our conclusion is that low-tech industries persist because of pervasive innovation within them: they are constantly renewed by technological upgrading, which accounts for their survival.

New classifications and taxonomies need to reflect firms' real competence

In WP2 we are concerned with issues that relate to WP1 described by Staffan Laestadius above. A good example and the thing we are currently working on is how the existing high-technology focus interacts with the prevailing classification systems and taxonomies of economic performance. It is the role of WP1 and WP2 on PILOT to criticise and uncover the weaknesses of these classifications and taxonomies. And it is important to work constructively toward the introduction of alternative perspectives to how knowledge formation, innovation and economic performance can be conceived and measured if low- and medium-tech industries are to receive the attention they deserve.

Our concrete work within this theme is for example focused on bringing in the firm level into the development of classifications and taxonomies, where OECD currently remains focused on the industry level. To us Baldwin and Gellatly ask the right question in their paper "Are there high-tech industries or only high-tech firms?" (1998). The answer seems evident. There can be high-tech firms in any industry, also in the food processing industry for example. It depends of course on how you define and measure high-tech. If we start the empirical investigation of this question with the most common definition of high-tech, namely by using the extent to which firms perform R&D as a proportion of sales, we evidently find firms across industries performing R&D as a sufficiently high proportion of sales to be called high-tech. This is a first indication that the existing taxonomy based on R&D on industry level needs to be improved. If this existing industry level taxonomy is applied as knowledge base for science and technology policy or innovation policy, the R&D-intense firms in other industries run the risk of being forgotten.

We argue that firms can be advanced and sophisticated, highly knowledgeable and competent, even without registered R&D activity at all. As an example we emphasise the importance of knowledge and competence embodied in firms' staff. This has led us to look at register data where we access the two most important variables in this case, individuals' formal education and training and their workplace. With this data we study the distribution of technologists (individuals with engineer competence or similar) to firms in the low-tech, medium low-tech, medium high-tech and high-tech industries. The results for Norway are shown in Figure 5 (p. 26).

The results indicate what we have hypothesised. If we for example apply a revised definition of high-tech as high competence, i.e. firms with 5 percent engineers in their staff, then there are high-tech firms in all three industries. In the high-tech sector more than 50 percent of the firms have more than 5 percent technologists. In the low-tech sector less than 5 percent of the firms have more than 5 percent technologists. The two medium tech sectors are in between these two extremes.

Using technologists as variable, as we have done in the example, provides much of the same results as if we use R&D. We can say this because R&D intensity and technologist intensity in firms correlate strongly. Nevertheless it shows us that there are knowledge intensive firms in all industries. It is our objective to investigate how variables that show less correlation with R&D can reveal distribution of knowledge intensity and distribution of knowledge formation in other ways. We are currently working on this and results will be ready during the winter 2004/2005.

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Annex

FIGURE 1: Shares of employment in total economy. 1980-1999. 11 OECD countries

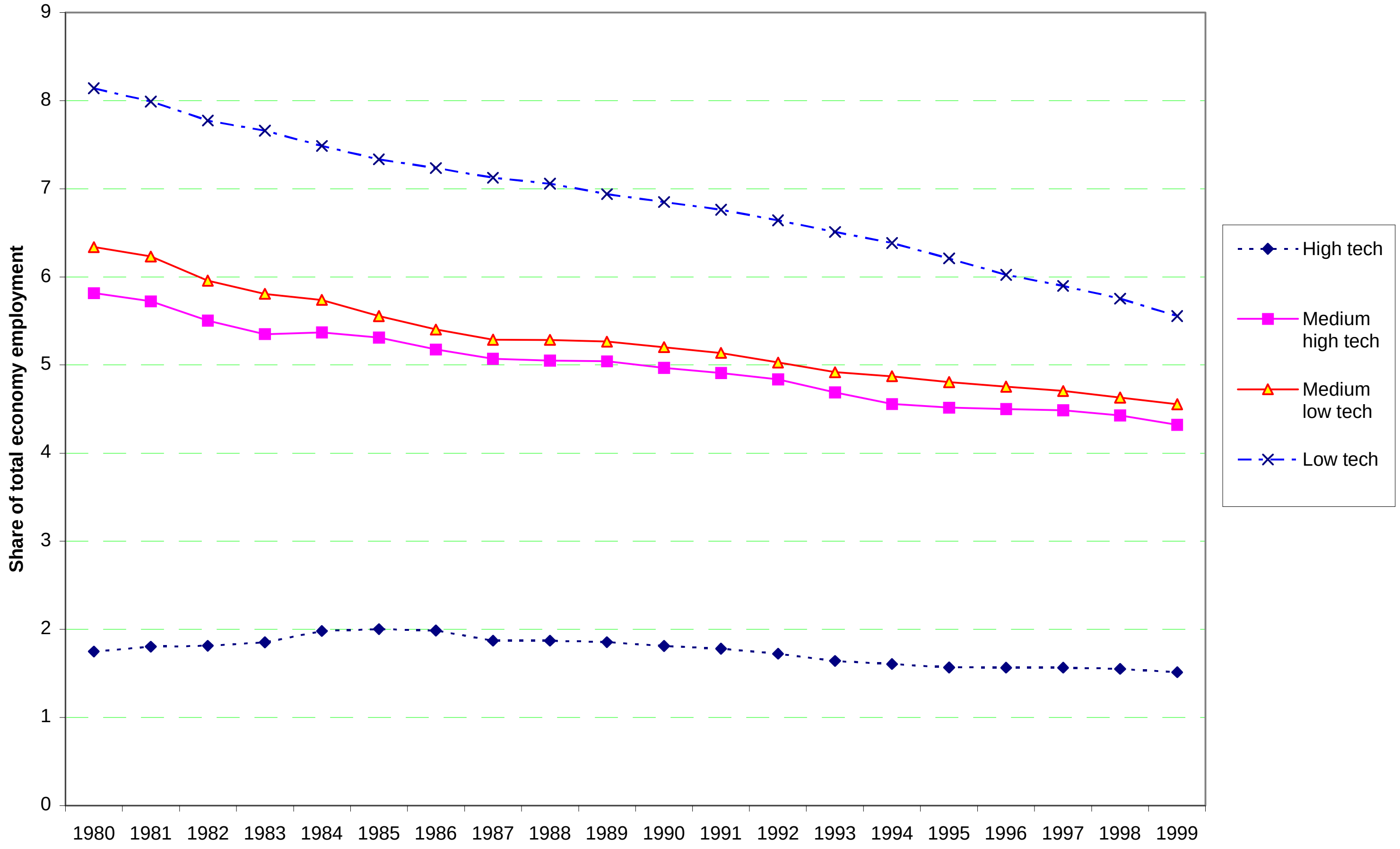

TABLE 1: Share of total employment in the economy by nine sectors. 1981 and 1998. Average (unweighted) for fifteen OECD countries

	1981	1998	Change
Agriculture, hunting, forestry and fishing	8.7	5.0	-3.7
Mining and quarrying	0.7	0.4	-0.3
Total manufacturing	21.8	16.7	-5.1
Electricity, gas and water supply	0.9	0.7	-0.2
Construction	7.3	6.6	-0.7
Wholesale and retail trade; restaurants and hotels	18.7	19.8	1.1
Transport, storage and communication	6.6	6.3	-0.3
Finance, insurance, real estate and business services	8.5	13.0	4.5
Community social and personal services	26.9	31.4	4.5
Sum all sectors	100	100	0

TABLE 2: Contributions of the four sectors to the overall manufacturing growth during the whole period 1981-98

	(1) Growth 1981-98	(2) Initial period share of VA	(3) Contribution to overall growth rate (1x2)	(4) Contribution to growth rate, per cent
High-tech	88.3	0.097776	8.6	32.7
Medium high-tech	28.2	0.303374	8.6	32.5
Medium low-tech	10.8	0.303162	3.3	12.4
Low-tech	17.0	0.295688	5.9	22.4
Total manufacturing	26.4	1	26.4	100

FIGURE 2: Shares of employment in total manufacturing. 1980-1999. 11 OECD countries combined.

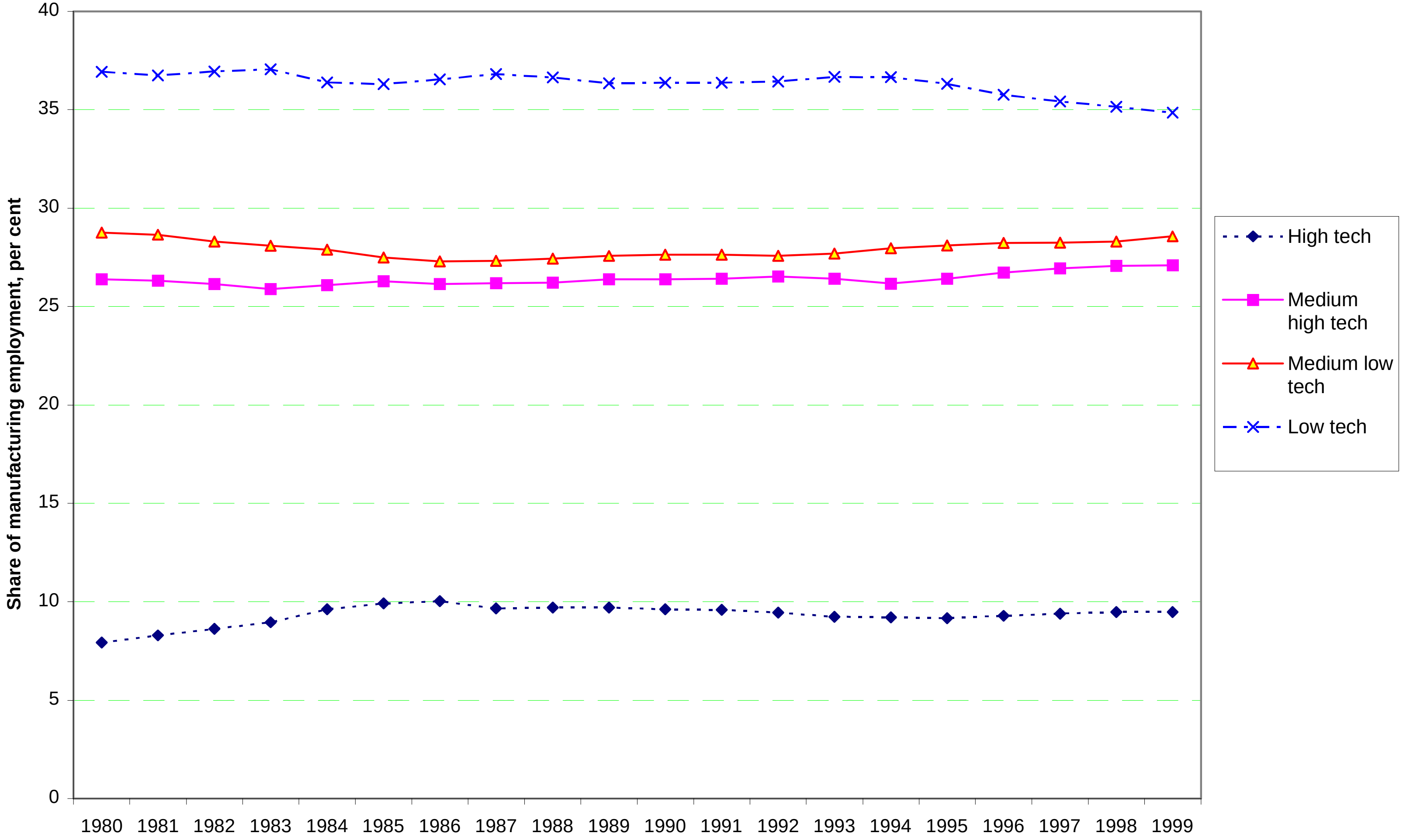

FIGURE 3: Production, exports, imports and domestic demand in medium low-tech industries 1980-1998, 11 OECD countries combined. Billion 1995 US dollars.

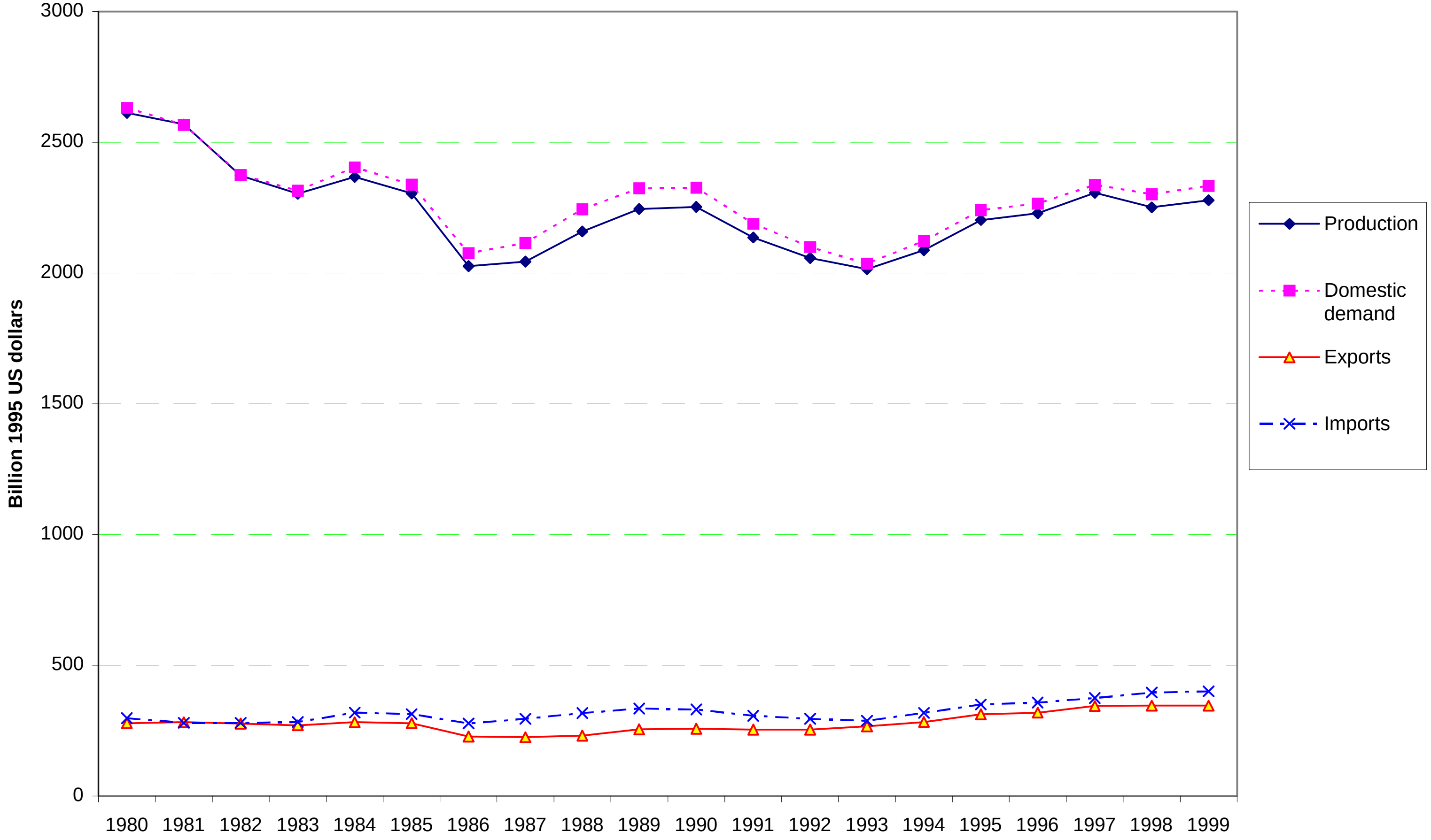

FIGURE 4: Production, exports, imports and domestic demand in low-tech industries 1980-1998, 11 countries combined. Billion 1995 US dollars.

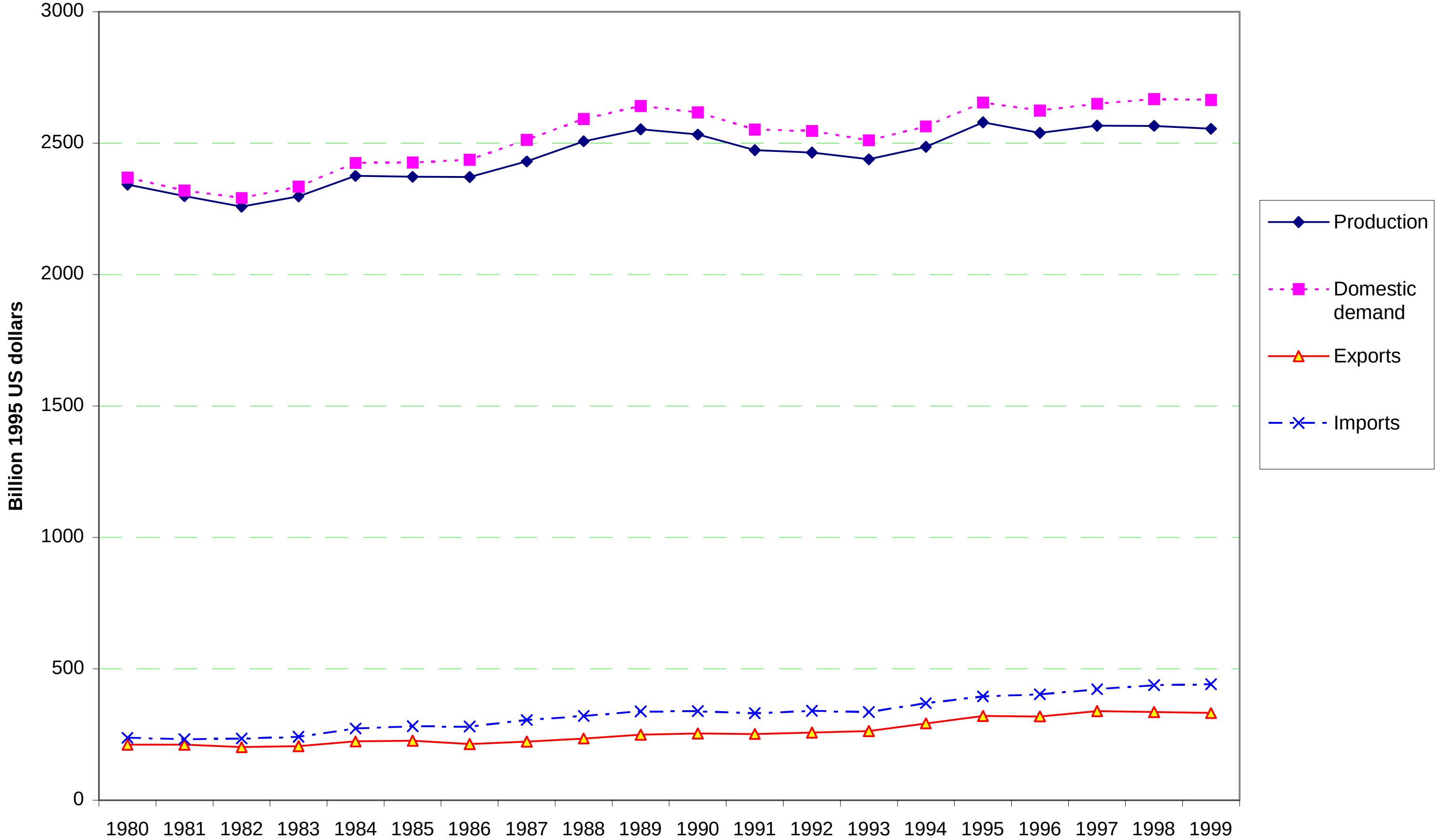

Figure 5: Technologists in Norwegian manufacturing, as share of employment in firms, 2001