Session IB: THE ROLE OF INDUSTRY IN REGIONAL TECHNOLOGICAL DEVELOPMENT

*****Abstract of session Ib "The role of industry in regional technological development"***

This session concentrated on the role of industry in regional technological development. An improvement of regional development calls for strengthening of industrial activities, requiring further exploitation of new high-technology.

On the other hand, local industry faces the global market - opening up market access worldwide and opening up competition in regional markets - which forces companies to adjust to increasing competition, continuous supply and on-going product development.

The regional integration of industry and technology should be supported by facilities that enable improvement of human skills, business services, financial markets etc. The demand for exploitation - utilisation of technology by companies - must be seen as a significant condition.

Prof. N. Komninos (GR) focused on the main obstacles for success of regional innovation support in *Less Favoured Regions (LFRs)*: latent integration of regional industry and technology both from the demand and supply side.

The first part of the paper presents regional innovation disparities : a comparison within less favoured and advanced regions of the European Union was elaborated. He underlined that there are huge disparities within innovation factors and that this causes the *"innovation gap"* which is far more important than the *"cohesion gap"*. The gaps are correlated due to the fact that regional disparities are nurtured by differences in technology and innovation.

Part two discussed the actions - such as RITTS[1] (a part of the action SPRINT[2]) - taken by the European Union to support LFRs, designed to bridge the technology/innovation gap and to sustain economic and social cohesion.

Part three evaluated the latent demand and supply side of technology and points out obstacles to efficient demand from industry, sufficient supply and transfer of technology.

Finally, Prof. Komninos suggested that future regional innovation strategies and EU policies should be targeted at motivating firms, for instance, to open new technology routes and to activate the demand side using innovation financing and technology auditing.

Prof. M. Luger (USA), presented an overview of how economic and production changes during the last 10-15 years have changed the principles for and approaches to Science and Technology policies (S&T).

He pointed out that the industrial landscape as well as the policy guidelines have changed over time and emphasised the increasing importance of S&T policies for economic improvements.

The three main parts of his presentation discussed (i) the changing industrial landscape (ii) general policy principles, and, (iii) examples of S&T approaches to the changing economic and industrial environment.

---

[1] Regional Innovation and Technology Transfer Strategies and Infrastructures
[2] Science Park Consultancy Scheme

A changed industrial landscape effects several factors of production: inputs, outputs, institutions and assistance. The global evolution undergone in industrial terms in the last two decades has been characterised by increasing knowledge, generating new opportunities for policy makers.

To meet these challenges Prof. Luger identified five principles to be incorporated in future action plans which must recognise the complexity of the new industrial landscape; the requirement of considerable resources; a change of traditional funding of projects; the varied needs of enterprises and the comprehensiveness in implementation of plans.

His theoretical findings were supported by an analysis of empirical examples in the final part of his presentation.

Mr. M. Obara (Japan) presented a paper based on Japanese political measures for promotion of Science and Technology in local development. Both present conditions and future directions were included in his presentation. The focus was on specific measures carried out by the Agency of Industrial Science and Technology (AIST) under the Ministry of International Trade and Industry (MITI).

First, the background of the Science and Technology Basic Plan (STBP) was described, influenced mainly by recent trends in the field of S&T.

Mr. Obara described the regional research institutes supported by AIST. These aim at enhancing regional industry technology, and they are intended to provide guidance and consultation to small enterprises. The effective operation of these research institutes is hampered by problems relating to: a limited number of researchers and insufficient financial resources. The SMEs (Small and Medium-sized Enterprises) play a major role, creating the largest potential for economic development in the regions. Therefore access for SMEs to research results and participation in research projects in general is of crucial importance.

Dr. J. Viana Batista (Portugal) ended this session by presenting a paper which identified the common understanding of a region in the context of RESTPOR. A region should be understood as a cluster of industrial activities upon which a system of innovation can be built.

The concept of regional industry is currently being challenged because of increasing importance of globalisation. Nowadays industries are more complex and it is essential to meet the requirements, for example, human skills, in order to understand and manage this complexity.

He raised the central question of whether it is possible to cluster the necessary elements for industrial and economic activities within a region.

Regional industrial improvements can, as tradition shows, be caused by enterprises attracting research institutions or vice versa. He pointed out the importance for transnational enterprises to account on increasing private R&D expenditures. Contributions from communication and information technologies are decisive as well as trade liberalisation and investments. Policy measures should therefore support the knowledge-oriented initiatives.

He concluded by underlying the difficulty of making intra-regional comparisons.

Conclusion of the session: The diversity and complexity of the situation were highlighted. Globalisation causes increased competition but also results in enterprises facing shortening adjustment periods. A shift of focus towards industry - a clearer demand side - is therefore required. Criteria for success are the exploitation of new technologies in traditional industries and a greater contribution from the EU relative to the United States and Japan.**

“Integration of industry and technology in peripheral regions”

by Prof. N. Komninos, Aristotle University of Thessaloniki, Thessaloniki, Greece

Introduction

From the beginning of the 1990s, European Community policy on regional innovation and technology introduced a new family of schemes, such as the Science Park Consultancy Scheme, the Regional Innovation and Technology Transfer Infrastructures and Strategies, the Regional Technology Plans Initiative, and the Regional Innovation Strategies, which tried to support technology and innovation in less favoured regions (LFRs) of the EU and to enhance regional competitiveness and development.

Although a comprehensive appraisal of these policies is not yet available, as most of them are in progress, this paper argues that the main obstacles for their success and the establishment of effective regional innovation support systems in LFRs are found in the *latent integration of regional industry and technology*, and the character of regional supply and demand for innovation and technology services. Technology and innovation demand in LFRs is extremely latent, and the main objective of regional innovation initiatives and policies should be to transform this latent demand to active. This change will permit regional innovation systems to be rooted in the decentralised actions of regional firms and not to be based exclusively upon the public initiative.

The papers start by presenting research and innovation disparities between advanced and less developed regions of the EU. Section two discusses a new family of regional policies and three schemes of EC regional and innovation policy, included into SPRINT and INNOVATION Programmes, and Article 10 Innovative Actions. The third section focuses on the characteristics of technology supply and demand in LFRs of the EU, and the final section develops some assumptions to deal with the problem of latent integration and regional innovation in LFRs.

1. Technology and innovation disparities in the EU

One of the new elements in the fifth periodic report on the social and economic situation of the regions in the European Community is the view that many of the causes of regional disparities in economic development may by traced to disparities in productivity and competitiveness[3]. In turn, regional productivity and competitiveness are considered as dependent variables of the capacity of regional firms to innovate the production process, to introduce new products in the early stages of their cycle, to lower costs through innovations in logistics, and to increase market adaptability. Innovation and intellectual property are the

---

[3] Regions compete each other, but regional competitiveness does not deal with competition in the usual economic meaning of the word. Regional competitiveness can be defined as the capacity of the region to attract and maintain firms with stable or increasing market shares in an activity while maintaining stable or increasing standards of living for those who participate in it. This capacity is based on the resources available in the region, the physical structures established in the region through time (infrastructures), and in the region specific endowment (Maskell and Malmberg 1995).

strongest drivers of competitive achievement. There are clear statistical links between R&D, management capability, intellectual property, innovation, and rising market share, growing added value and jobs creation (CEE 1994a).

While innovation has become a key issue for the wealth and prosperity of the regions, quantitative data and a number of reports have established that the geographical distribution of technological and innovative effort in the European Union is extremely unequal. Many of the factors sustaining innovation, Research and Technological Development (RTD) in particular, are unevenly distributed between EU regions (see Table 1).

Table 1. Geographical distribution of innovation factors

	GR	P	ES	IRL	DK	NL	FR	D	EUR
GDP per head (1993)	49	60	76	78	106	109	109	117	100
Unemployment % (1993)	7,8	4,9	21,3	18,4	10,6	8,2	10,3	7,0	10,4
GERD as % of GDP (1990)	0,47	0,50	0,87	0,91	1,54	2,06	2,42	2,81	2,00
BERD as % of GDP (1990)	0,10	0,12	0,52	0,55	0,85	1,11	1,48	2,02	1,30
Government RTD as % of budget (1988)	0,60	0,98	2,19	0,98	2,28	2,50	6,91	4,11	3,24
RTD scientists per 1000 labour force	1,4	1,1	2,2	5,0	3,8	4,0	5,1	5,9	4,2

Source: CEC 1994a (GDP: Gross Domestic Product, GERD: Gross Expenditure in Research and Development, BERD: Business Expenditure in Research and Development)

These figures suggest that regional disparities in factors of innovation (RTD, BERD, R&D scientists) are far more important than disparities in GDP and unemployment.

- The Community four weakest members (Greece, Portugal, Spain, and Ireland) have R&D expenditure levels which are two to three times lower than the Community average. The gap in terms of gross R&D expenditure is 1 to 6, while in terms of income per head is 1 to 2,5.
- Business expenditure for R&D in Greece and Portugal are one tenth of the community average, and 15 to 20 times lower than in France and Germany. State expenditure for R&D in the same countries is one fourth of the community average.
- R&D personnel in Greece and Portugal is only one quarter to one fifth of the same personnel in the more advanced states, and one third of the community average.

Furthermore, in the member states, R&D activities are usually concentrated in few areas, around capital cities and metropolitan areas. Resources for research and development, the large research institutes, the engineers and scientists that work in research, all of these are concentrated in a small number of regions, the so-called «islands of innovation», such as London, Paris, Stuttgart, Munich, Lyon, Grenoble, Toulouse, Turin and Milan. On Europe's fringes, the scant technology resources are concentrated mainly in the national capitals of the member states and their large metropolitan centres. In Spain, Greece and Portugal, 60-90% of all public and private spending on R&D occurs in Madrid, Athens and Lisbon respectively (CEC 1994a).

The regional technology and innovation gap, measured by regional disparities in R&D, innovation financing, scientific personnel, technology infrastructure, is far more important than the "cohesion gap" between developed and less developed regions of the European Union. The technology gap is important both in quantitative terms, and in terms of effects on the convergence process since it reproduces and enlarges the cohesion gap. Furthermore, as M. Landabaso (1995) points out, the existing arrangements for public assistance are tending to increase the technology gap between more advanced and less favoured regions.

Cohesion crosses dynamically the innovation capability of less favoured regions, as regional disparities are nurtured by disparities in technology and innovation. This correlation has introduced a clear interest for the diffusion of technology and innovation, both in the framework of R&D programmes, and the regional and cohesion policy of the European Commission.

2. EC strategies for regional innovation support

Innovation support and technology diffusion in less developed regions were supported by various actions of the R&D framework programmes targeting on R&D and technology dissemination (SPRINT, Value, Innovation Programme, etc.), the Community Support Framework, and the Community Initiatives designed to encourage R&D in peripheral regions.

However, a different approach was recently crystallised in a new family of schemes developing a *strategic* view for technology and innovation in LFRs. More important were the Science Parks Consultancy Scheme, the Regional Innovation and Technology Transfer Infrastructures and Strategies, and the Regional Technology Plans / Regional Innovation Strategies.

Under the SPRINT Programme were developed both the Science Park Consultancy Scheme and the Regional Innovation and Technology Transfer Strategies and Infrastructures (RITTS). These are actually included into the INNOVATION Programme of the 4th R&D Framework Programme.

The Science Park Consultancy Scheme supports new and existing science parks, research parks, technology parks, and business innovation centres, in order to define the next stage of their development, to widen their role in the respective local/regional economies, to improve their networking, to change their focus and strategy, and to define a strategy compatible with their economic and technological environment (SPRINT 1994). The development of a strategic approach for these infrastructures is divided into two stages. The first stage involves a background analysis to demonstrate whether the initiative is needed and has a good chance to proceed to a successful implementation. The second stage is much more operational and concerns the formulation of a detailed development plan for the initiative.

RITTS are addressed to regional governments and associated regional development organisations wishing to improve or change the strategic focus of infrastructures and services for innovation and technology transfer. The scheme covers a wide part of the Community, not just objective 1 or 2 regions, and it has a trans-national dimension in order to encourage the spread of best practices. Overall, 23 projects for regional innovation and technology transfer were supported, and another 20 projects are actually in progress. On the methodological level, the scheme is divided into three stages. The first stage is concerned with drawing up an inventory to define infrastructure support elements, business needs for R&D, and types of possible public intervention; the second stage is concerned with the examination by a steering Committee of the strengths and weaknesses of the regional economy and the definition of a development plan; the third stage focuses on the implementation of the plan and the establishment of follow-up mechanisms (CEC 1994c).

In the framework of cohesion policy and the Structural Funds, a parallel scheme has been developed. Regional Technology Plans (RTPs), renamed Regional Innovation Strategies (RIS), are initiatives aiming to enhance the synergy between technological development policy and cohesion policy. RTPs were launched in four Objective 1 regions and four Objective 2 regions, and recently 19 new projects have started. Typical deliverables of a RTP/RIS project include the definition of a strategy for regional technological development, which assure the consensus of the main regional actors in the public, academic and private sectors, and the design of an action plan including innovation support measures to be implemented through the Community Support Framework and Community Initiatives (CEC 1994b).

These schemes introduced strategic approaches on regional innovation and development along three distinct axes: (1) the creation of technology poles in peripheral areas, (2) support for research and technology supply infrastructure, and (3) the identification of the structural factors behind the technology deficit and the support of regional innovation systems.

The *"technology poles strategy"* was implemented on a broad scale through technology parks and various "technopolis" programmes. In its fullest form, this strategy combines interventions in three domains: (1) interventions in the technology supply system and the technology transfer mechanisms, (2) interventions in the industrial system with the development of high-tech firms, local linkages and networks, and (3) interventions in the infrastructure with the qualitative up-grading of the environment and organisation of spaces for business services. In a peripheral region, the technology pole starts out as a distinct «pocket», which may be created by the market or by the state or by the local community. It is usually the result of the modernisation of established businesses, the up-grading of local branch plants of multinational corporations, the establishment or relocation of government research and technology institutes, or the attraction of high-tech firms. The new pole fosters the development of networks and collaboration among existing firms, both on the economic level between producer and supplier, and on the level of communications and information technology infrastructure (see Komninos 1993). In many peripheral regions, such technology poles have drastically altered the character of economic activities and ushered these areas into a new development trajectory.

Support for technology infrastructure is a supplementary strategy which found expression in the creation of research institutes and technology centres in many in Europe's less developed regions. This strategy focuses on the supply side of technology, adopting a «linear model of innovation», in which a region's innovative activity is taken to be a direct function of its research and development capability. This false equivalence between innovation and research significantly limited the multiplier effect of this strategy and created the prerequisites for a more complex approach to dealing with the technology gap (see Komninos 1996).

Finally, the *support of a regional innovation systems* initially attempts to bring to the surface the main factors behind the region's technology deficit: the archaic character of its small and medium-sized businesses, the inadequacies of its mechanisms for the diffusion of technology, the character of demand for technology and innovation services. It adopts a more integrated way of dealing with innovation, a systemic model of interaction between technology supply and demand, and a more comprehensive concept of innovation. Basic differences between this strategy and the previous ones are in the promotion of a decentralised regional innovation system, the exploitation of the existing industrial and research capability of the region, as well as the emphasis on the demand side of the innovation process.

Besides the differences in the focus and coverage areas, these strategies were aiming to encourage the development of a new type of innovation infrastructure and to improve the capability of local and regional actors to design adequate policies corresponding to the needs of the productive sector and the strengths of the scientific community. A common and overall objective was to bridge the technology gap between EU regions and to sustain economic and social cohesion.

3. Latent technology and innovation supply and demand

In a number of SPRINT and RTP projects developing strategies for regional innovation support in less favoured EU regions[4] (Andalusia in Spain, Mezzogiorno in Italy, Crete and C. Macedonia in Greece), it was stated that major obstacles for setting operational and effective regional innovation systems rise from the latent supply and demand for technology and innovation.

By *latent technology supply* we characterise the informal operation of the system for the technology supply and transfer, in which the in-flows of technology and innovation in the industrial sector are not recognized as distinct issues. Field research in the above mentioned regions reveals that this is associated with three events:

The main route by which businesses acquire new technology is through the purchase of mechanical equipment. In-house R&D departments are rare, although in some cases R&D is carried out by production and quality control departments.

Inter-firm collaboration, which is a major source of technology know-how, is primarily in the form of subcontracting. The subcontractor works according to the plans, production methods and product specifications provided by the principal: this dependence seriously restricts motivation and the incentives for innovation.

Technology dissemination and collaboration between industry and research are both limited. Research activity is primarily concentrated in university laboratories, where it is fragmented among numerous small units without any specific clear industrial goal or connection. This is a structure that does not allow for the development of complementarity, interdisciplinary activity or the constitution of large-scale poles of competence.

All three routes for technology supply in industry and in SMEs in particular (technology purchase and licensing, technology exchange, technology dissemination) are covered by broader activities and relationships: the purchase of technology by the purchase of equipment and machinery, the exchange of technology through subcontractual relationships between firms, and the technology dissemination via the loose relationships between industry and the universities. Academic activity, sub-contracting relations, and machinery purchase are buffers to actions aiming to introduce innovations and restructuring into the technology transfer and supply system.

By *latent technology demand* we characterise the lack of active technology demand and the low awareness in industry about the capabilities of new technologies to deal with production,

[4] See, Cappelin R. and A. Tosi (1993), Chef J., Komninos N., D. Mercier, and A. Tosi (1995), Komninos N., D. Mercier, and A. Tosi (1996), RTP C. Macedonia (1996).

competition and marketing problems. Latent technology demand is documented either from the stratification of firms and the small proportion of firms that expresses clear views on technology and innovation inputs, either from the comparison between in depth technology audits and technology market research in the same population of firms.

Lack of awareness and low information inputs bound the capacity of firms to understand their real needs and to develop adequate solutions to fulfil these needs. This concerns both the spheres of marketing and production.

Market fluidity and globalisation of competition made information on market requirements extremely complex. Barriers for relevant and in time market information are sharper in firms that usually operate into regional and national markets. It is well documented that during the current industrial configuration, technology and innovation are market driven, as markets set productivity and product quality standards. However, there is a serious gap between markets and changing needs for product quality and specifications, as well as for flexible solutions to adapt the production processes. Peripheral firms have an additional difficulty to follow and fill this gap.

On the other hand, a constant trend appears in firms operating in peripheral regions to seek competitiveness through defence strategies of deskilling, low use of human resources, and exceed investment in equipment and automation. Innovation needs are concealed both in the production process, where automation problems prevail, and in product development where prevailing problems are those of quality than new product design and development.

Latent technology demand, with respect to market globalisation and defence production strategies of deskilling, undermine innovation initiatives developed on an entrepreneurial basis. It is documented by technology audits that many private firms, offering R&D, technology and innovation services, have underestimated the effort needed to open the market and the difficulty to develop the SME's appetite for these services.

4. Regional innovation and latent integration of industry and technology

Latent technology supply and demand or *latent integration of industry and technology* constitute major obstacles for regional innovation[5] in peripheral regions. In the supply side, the neglect of local R&D resources prevents regional firms from technology inputs based on local scientific skills and expertise. Low interfirm technology co-operation weakens technology inputs from an important technology transfer route, as well as local technological consolidation between producers and suppliers. Rationalisation of technology supply is poor as far as competition between technology suppliers remains low. Regional firms lack both in-house technology capacity and external input from their immediate environment.

In the demand side, low active demand for technology and innovation services do not sustain a regional technology market to prosper, neither the clustering of innovative firms and the positive multiplication effects of a vivid regional technology pole. The private sector remains out of the R&D and innovation activity, and the innovation support system and services are placed exclusively under the public initiative.

[5] Following the concept of regional competitiveness, regional innovation may be defined as the environment which permits firms to make extensive use of innovation factors, such as risk capital financing, technology transfer, technology services, etc., in order to innovate the production process and to design and market new products.

However, latent integration of industry and technology should be not considered as informational and knowledge problems. In a number of recent theoretical approaches, innovation was related and explained mainly with respect to learning processes. P. Maskel and A. Malmberg (1995) have discussed a growing literature on localised learning, innovation, and industrial and regional competitiveness (see also, Patchell 1993, Storper 1993, Simmie 1996, Howells 1996), in which main arguments are that:

> It is the ability of regions and countries to learn, change, and adapt rather than their allocative efficiency which determines their long-run performance.

and

> As knowledge become a crucial asset in modern production systems, the ongoing creation of new knowledge has become a key process when trying to increase/sustain competitiveness. The competitiveness of an increasing number of firm is no longer primarily obtained by cost-reduction, for instance in labour wages, but mainly by generating entrepreneurial rents through innovations in the production process, by accessing new, distinctive markets in new and unconventional ways or by producing new, improved or redesigned commodities or services with a significant contribution to the perceived customer benefit of the end product.

There is not doubt that innovation has become a key factor for industrial competitiveness. However, less dependable is the notion of production and product innovation as learning processes, and the equation of innovation to knowledge capacity. Information and knowledge are important innovation factors, but in the absence of a comprehensive theory of innovation they cannot be considered either exclusive or the most important ones. Other factors may be equally important in the innovation process, such as adaptability, intelligence, strength, long term pursuit of objectives, etc. [6].

On the contrary, field research in the regions of Spain, Italy, and Greece mentioned earlier, suggests that the informal technology supply and the lack of active technology demand, which resume latent integration of industry and technology, are rooted in neo-taylorist corporate strategies in production, product, interfirm relations, and employment, and in the poor business environment for technology and innovation.

Taylorism has produced a spatial fragmentation of production activities between qualified and non-qualified skills, and a location of the latter in peripheral, semi-peripheral and agricultural regions. Neo-taylorism, as an option of current productive restructuring and re-engineering, is deepening the taylorist production divide and deploy corporate strategy along four main features: (1) restructuring of production with respect to exceeding automation and process machinery, (2) export-oriented product design and specifications, (4) further functional and spatial separation of specialised and routine activities through the externalisation of tertiary activities, sub-contracting, and international integration of firms (4) labour market flexibility based on deskilling, low wages and on-off mechanisms adjusting the labour mass to market fluctuation.

---

[6] Innovation may be defined as equation of research, invention, and commercial exploitation. (innovation = research + invention + exploitation). Research and commercial exploitation are normative, and established rules and models command their practices, while invention is a black box having as input a variety of factors including information, knowledge, culture, intelligence, co-operation, etc., and which is assumed to be rather unpredictable (see, Drejer 1996).

Neo-taylorist strategies have become dominant solutions in peripheral productive restructuring because of the specific characteristics established in less favoured regions: precarious industrial base, skill shortages, traditional local technical culture, and lack of innovation support services and infrastructure. In these areas, exceed use of automation and the integration of firms into wider production networks allow to minimise local technology inputs and conceal the real needs for technology and innovation.

In conclusion and going back to regional innovation strategies, I would suggest that regional policies should primarily deal with the latent technology supply and demand, if it is to reduce technology and innovation disparities. However, solutions should not be searched in training schemes and information exchange exclusively, as a "knowledge shortage" explanation of the innovation gap may suggest. More appropriate may be those actions that motivate firms to change their corporate strategy: on the one hand to open new technology supply routes, to use regional research resources and to develop networks for technology co-operation, and on the other, to transform latent demand to active, using innovation financing and technology auditing. These combined actions may contribute to open choices and set alternative trajectories for corporate strategy, which are not framed in neo-taylorist solutions and low intelligence production strategies.

References

Cappelin R., A. Tosi (1993), Politiche Innovative nel Mezzogiorno e Parchi Technologici, Milano, FrancoAngeli.

CEC (1994a), *Competitiveness and Cohesion: Trends in the Regions*, Fifth periodic report on the social and economic situation and development of the regions in the community, Luxembourg, Office for Official Publications of the European Commission.

CEC (1994b), *Regional Technology Plans Guide Book*, 2nd Edition, DG XVI / DG XIII.

CEC (1994c), Good Practice in Managing Transnational Technology Transfer Networks. Ten years of experience in the SPRINT programme, DG XIII & Coopers-Lybrand.

Chef J., Komninos N., D. Mercier, A. Tosi (1995), *Innovation Centre in Andalusia Technology Park*, report to CEC, DG XIII.

Drejer A. (1996), "Frameworks for the management of technology: towards a contingent approach", *Technology Analysis and Strategic Management*, vol. 8, no 1, pp. 9-21.

Howell J. (1996),"Tacit knowledge, innovation and technology transfer", *Technology Analysis and Strategic Management*, Vol. 8, no 2, pp. 91-107.

Komninos N. (1993), Technopoles and Development Strategies in Europe, Athens, Gutenberg.

Komninos N. (1996), "After Technopoles: diffused strategies for innovation and technology transfer", in J. Simmie (ed) *Innovation, Networks and Learning Regions*, London, J. Kingsley Publishers.

Komninos N., D. Mercier, A. Tosi (1996), *Science Park of Technical University of Crete*, report to CEC, DG XIII.

Landabasso M. (1995), "The promotion of innovation in regional Community policy: lessons and proposals for a regional innovation strategy", International workshop on regional science and technology policy, RESTPOR 95, Himeji, 13-16 February 1995.

Maskell P. and A. Malmberg (1995) "Localised learning and industrial competitiveness", paper presented at the Regional Studies Association European Conference on Regional Futures, Gothenburg, 6-9 May 1995.

Patchell J. (1993), “From production systems to learning systems: lessons from Japan”, *Environment and Planning A*, vol 5, pp. 797-815.

SPRINT (1994), *Science Park Consultancy Scheme*, Core specifications and application forms, Luxembour, DG XIII.

Simmie J. (1996) (ed), *Innovation, Networks and Learning Regions*, London, J. Kingsley.

Storper M. (1993), “Regional worlds of production: learning and innovation in the technology districts of France, Italy and the USA”, *Regional Studies*, vol. 7, pp. 433-455.

RTP C. Macedonia (1996), *Regional Technology Plan of C. Macedonia - Interim Report*, Report to CEC, DG XVI and DG XIII.

"The Changing Industrial Landscape, Knowledge, and Regional Economic Development Policy"

by Prof. M. I. Luger, University of North Carolina at Chapel Hill, NC, USA

Introduction

The world economy has undergone significant changes in the past ten years. The "new world order," as it has been called, has been shaped by the continued rapid industrialization in the Pacific Rim, the emergence of new market economies in central and eastern Europe, the erosion of long-standing trade barriers which has resulted in freer trade, and other types of deregulation. These changes are so widespread, that labels such as "global, high tech" and "post-Fordist" do not go far enough in describing them.

As production and global economic relationships have changed, governments, donor organizations, and other groups have questioned whether old approaches to industrial development are appropriate, and in many instances have contemplated or experimented with new policy thrusts. In the old economic order, only advanced countries had what can be called "science and technology policy;" today, that is a feature of policy elsewhere.

These two stylized facts—that the industrial landscape has changed, and that governments (and others) are casting about for policy guidance in light of those changes—motivate this paper. I characterize the changing industrial landscape, especially in terms of greater knowledge requirements. Then, I discuss general principles for policy action that are consistent with different types of industrial economies. Finally, I illustrate my arguments with particular examples.

The New Industrial Landscape

The changing industrial landscape is reflected in each of the inputs commonly used in production: labor, physical capital, infrastructure, and finance; in the way output is distributed; and in the institutions that support production.

Changes in Industrial Inputs

Labor skill requirements are changing in less- as well as more-advanced economies. Even "unskilled" workers in low cost assembly operations in China, Thailand, Eastern European countries, and elsewhere, increasingly need to read and acquire skills to operate more sophisticated equipment—for example, machines that are computer assisted or controlled.

Precision equipment and appropriately-trained operators are increasingly necessary, even in the mass production and assembly of lower-valued goods, for two reasons. First, rapid industrialization in low cost countries puts pressure on wages more quickly than in the past. Second, precision and consistency are required to meet the quality standards set as part of "outsourcing" contracts, and quality assurance requirements (such as ISO 9000 and 14000) that are being incorporated into import and environmental regulations.

Infrastructure requirements are also changing for many enterprises. Globalization and increased competitiveness require that even low wage production facilities are well connected with the rest of the world. "Speed to market" is becoming increasingly important as a means for businesses to compete. That means that the time to fill and ship orders must be minimized, which requires good telecommunication, good transportation, and good proximity to markets.

Good communications and telecommunications links also are required for enterprises to exploit their location within clusters—and communicate with buyers, suppliers, similar manufacturers, and other facilities within the same corporation (if the enterprise is a branch plant). Improved transportation is important for enterprises located in large cities that increasingly are beset with congestion, making the journey to work more difficult for workers, and the transportation of finished goods more costly. Good telecommunications and transportation facilities also can make location away from congested urban centers more desirable. Environmental infrastructure has become more important, as environmental regulations have become more widely enforced in developing and emerging countries.

In some developing countries, public infrastructure is poorly provided: electricity and water supply are sporadic, solid waste is not collected or disposed properly, postal deliveries and telecommunications are not reliable, and roads are poorly maintained—even though rates charged are often very high and inefficiently set. That puts enterprises in those countries, especially SMEs, at a competitive disadvantage in the global marketplace. They either operate inefficiently as a consequence, or face additional expense to provide their own infrastructure services (see Luger, 1989.)

Industrial finance must be changed as well to accommodate the needs of sole proprietors and emerging entrepreneurs, who often lack personal resources, have no access to bank financing, and are not part of large, well capitalized corporations. The proprietors and entrepreneurs to whom this applies include, for example, small businessmen in the north of Italy, emerging entrepreneurs in the former Soviet bloc and southeast Asia, and craftswomen in India and Africa.

Changes in the Distribution of Output

Shipping requirements for finished final and intermediate goods are also changing, as just-in-time production becomes an increasingly important means for controlling inventory costs, and single plant enterprises broaden their network of buyers. This has implications for the location of establishments—near appropriate existing transportation and communications facilities, and for the construction of new transportation and communications links.

Changes in Institutions

New institutions need to be considered to provide the infrastructure services and financial instruments that are required as part of the new industrial landscape. Especially in new market economies, existing general purpose governments may not be suited to respond to the needs of new private enterprises. Bond markets in many developing countries are not well developed, making it difficult to spread the cost of capital projects among users at different points in time. And, universities in all countries are rethinking their institutional role in society, as they face greater external and internal pressures to participate in regional economic development (see Goldstein and Luger, 1997).

The Widening Variety of Industrial Needs

The kinds of enterprises represented both within a given country, and among countries, can vary widely in terms of size, type of ownership (single plant, branch plant), connectedness to the broader economy, technical requirements for the good being produced, location relative to workforce, materials, and markets, and more. Enterprises of different types require different kinds of assistance. A good assistance program must recognize that.

Knowledge as an Organizing Concept

“Knowledge” is the common denominator for the changes identified above. In short, inputs and outputs have increasingly high knowledge content.

“Knowledge inputs” include *knowledge workers* (skilled labor), notably scientists and engineers who bring specialized human capital to the production process; *knowledge infrastructure*, including information hardware, networks, and high speed communication facilities, and *knowledge institutions*, such as universities and research labs and centers. These inputs, plus finance, create knowledge outputs, which is measured in terms of patents, reports and publications, and bytes of information. For completeness, we can also define “knowledge finance” to include venture capital, equity investments, and other innovative mechanisms that underwrite the cost of knowledge output generation.

Implications for Policy

The preceding discussion identifies challenges for policy-makers and assistance organizations There are at least five principles that need to be incorporated into a plan of action that would be consistent with the new industrial landscape.

- An appropriate response must recognize the complexity of the new industrial landscape. This complexity is a reflection of globalization and increased competitiveness. Enterprises are either part of trans-national corporations, or through various networks, deal with other enterprises in different locations. These trans-national connections require a broader and deeper knowledge of many countries’ (and regions’) economic trends, customs, and regulations. This suggests that an important new activity is to be a provider of information.
- An appropriate response will require considerable resources, especially if a regional development approach is pursued, through which new and improved infrastructure could be provided and networks established. Considerable resources are required when relatively laggard regions are targeted for development, as part of a national balanced growth strategy.
- An appropriate response must recognize that traditional sources of project funding are changing, as are the criteria for their distribution. Increasingly, matching funds are required from local sources (what the EU calls subsidiarity).

The three bullets above suggest the importance of developing multiple donors/multiple governments to cooperate on projects.

- An appropriate response must be flexibly targeted, not formula-based—recognizing the varied needs of enterprises. Indeed, an important part of technical assistance should be to assess the development capacity of the target region and help to construct an appropriate strategy for industrial development in that context. That is very much consistent with Porter’s claim that every place has some unique strength that must be discovered and developed (Porter, 1990). The elements of that strategy should include, but not be limited to, what has been discussed here.

- An appropriate response must be comprehensive
  - because of the complexity and the changing patterns of funding, it is important to bring all key actors into the planning and implementation of an assistance strategy: city, regional, central governments; industry. (We might call this “stakeholder facilitation”)
  - also because of the inherent complexity of the problems, it is important to conceive of services as a complementary bundle: training, infrastructure, finance, marketing, etc. can constitute a package of “knowledge services” such that the whole is greater than sum of the parts.

Appropriate Policy Interventions

The types of assistance likely to help make enterprises competitive in this new global, technology-oriented, knowledge-intensive economy vary, depending on the size, organizational structure, and position of enterprises in the global production chain, as well as on their location along a development trajectory. Luger (1996) explains that knowledge inputs and outputs are continua that generally move in the same direction as economic development (broadly defined).

As a country or region moves up the economic development curve, various features of the economy tend to change. At low levels of economic development, the economy tends to be dominated by plants engaged in production and assembly, either locally-owned SMEs, or branches of multi-plant firms controlled from outside the region. The goods that are produced typically are locally consumed in lieu of imports (import substitution). Good road and rail systems are important for the plants to receive intermediate goods and to ship finished products to market. Reliable phone and postal systems are important to ensure regular, if not immediate, access to customers and suppliers. And, the labor input is not particularly skilled.

At the next step in development the local plants have strengthened, perhaps finding a niche as an SME, or becoming a regional headquarters of a larger firm. The country or region can become what Shive (1992, 1994a) refers to as a “regional operations center.” “The basic idea of a regional operations center,” he says, “is decentralization of decision-making within the parent company to a local division or subsidiary which is responsible for all regional business” (Shive, 1992: 2).

Some low-level R&D occurs as these businesses adapt goods for the regional market. Engineering-intensive research seeks to improve product design, to make goods that are better and less costly to produce than elsewhere (a prime example being Interlego A.G., the Scandinavian manufacturer of Lego blocks). To control the larger market area and compete successfully, more rapid communications and telecommunications are needed. The workers also need more skills, including technical, administrative, and managerial. The export of goods outside the region generates income, which enhances the consumer and service sectors.

Farther up the curve still, successful businesses become more specialized with larger markets. Some businesses are national or international headquarters. Production and assembly and regional market functions are hived off to regions lower on the curve. High-level R&D produces new ideas, products and processes, with high content knowledge workers and knowledge-intensive infrastructure and institutions. Regions at this level grow wealthier as their physical and human capital deepen.[7]

To a large degree, development is cumulative, so more advanced countries will have regions and/or sectors that are still best described as having low knowledge-content. The significant point for policy is that "appropriate" actions either fit the needs of businesses that are defined by the point along a trajectory, or consciously help move industry up and to the right on the curve.

We also can discuss a continuum along the economic development curve of the type of activities in which businesses must engage. The first general activity for businesses at lower levels of development is to improve production techniques and inputs, to ensure that production and assembly can be done profitably. Workers have to be trained to use machines, including some machines that are computer assisted (CAM). In economies dominated by SMEs, business owner/operators need to be trained in proper management skills, and brought into contact with other business owner/operators. And multi-plant firms need to be networked for real time communication. Established firms engage in applied research, to adapt generic products for local markets (for example, producing cars with right-side steering for Asia), to exploit locally-grown produce and locally-available resources (for instance, rubber in Malaysia), and to add value to exported goods. So, for example, instead of exporting raw pineapples, the fruit would be processed and canned locally and then shipped. Established firms also engage in product redesign, to improve existing products, to make them more competitive in world markets. These activities are consistent with the export promotion stage of development.

The highest level of activity is basic research—applying science to solve problems of general concern. Specialized equipment and facilities (linear accelerators, supercomputers, etc.) are the knowledge inputs, and refereed publications are often the knowledge outputs. Jaffe, Tratjenberg, and Henderson (1992) refer to those outputs as non-appropriable, as opposed to the more specific outputs from basic research that can be done for and used by (appropriated by) specific businesses. Both applied and basic research can lead to the commercialization of new products. Commercialization activities include patenting and licensing, obtaining start-up or expansion financing, and the penetration of new markets.

These obviously suggest different services that businesses would find useful along the continuum. For businesses (or aggregations of businesses in parks) in less developed economies, worker and managerial training and technical assistance are important, as is the availability of pilot plants to learn processing techniques, and help establishing buyer-supplier networks to reduce costs. At the next level, businesses need better skilled workers, and must make sure their products meet international standards (for example, ISO 9000), so need access to testing and calibration equipment. They also can benefit by linking to the local university, for technical assistance and access to trained workers. To the extent that businesses are growing, and are beginning to engage in collaborative production activities, the availability of crunch space may be important. At the commercialization stage, businesses benefit from patenting and licensing assistance, matching services to financing or the provision of public gap or venture capital, entrepreneurial training, marketing assistance, and the availability of incubator space. And companies involved in basic research value public provision and

[7] This accords with actual data on the wealth of countries, as reported, for example, by the World Bank. See "World Bank Ranking of Nations Wealth Puts Australia on Top, U.S. 12th." Wall Street Journal, September 18, 1995, p. 2.

operation (or subsidization) of specialized equipment and facilities, links to knowledge resources, and the maintenance of a healthy and attractive work environment.

Understanding the New Policy Landscape: Some Examples

In this section, I present some examples of policy initiatives that can be understood in terms of the five principles articulated above, and/or my conceptual framework. The examples I present are from countries that differ widely geographically and economically, but are all undergoing rapid changes in their industrial landscapes. These are just a few of hundreds of possible examples.

Some caveats are in order. I do not mean to suggest that policy-makers in these selected cases were conscious about the "logic" of their actions. Indeed, as in most cases of innovative policy, there has been some trial and error (see Osborne, 1988). I also do not exclude the possibility that these policies, as "right" as they may be, were made for the "wrong" reasons (for example, for the symbolic value, out of sheer hope, or simply to emulate perceived success elsewhere). Further, I make no claim about the effectiveness or efficiency of these policies (see Luger (1987)). I present them merely to illustrate some policy thrusts that are consistent with the new industrial realities I have described.

The Global TransPark

I noted above that globalization and increased competitiveness require that even low wage production facilities are well connected with the rest of the world. "Speed to market" is becoming increasingly important as a means for businesses to compete. That means that the time to fill and ship orders must be minimized, which requires good telecommunications, good transportation, and good proximity to markets. And, I discussed how air connections are more important the farther up the development trajectory we move. Finally, among the principles to be followed, I noted the importance of deep pockets, especially when developing laggard regions, using resources from multiple sources, and "bundling" of services.

The Global TransPark implements these guidelines. The TransPark is really a system of two or three (or possibly more) airport facilities. The farthest along is planned for 15,300 acres near Kinston, North Carolina. Another is targeted for eastern Thailand, and a third for western Europe. Other locations have been discussed.

The TransPark will provide a location where cargo planes can dock next to manufacturing or assembly plants or warehouses. Without having to maintain inventories of parts or goods, companies could fly in materials, process or assemble them and fly the to and from the complex. Orders would be received electronically through links on the information highway.

The logic of the network of parks exploits regions' comparative advantage. Component parts would be manufactured where labor is cheaper, in southeast Asia. The parts would be flown to North Carolina and western Europe and assembled in a less labor-intensive manner. The heavier finished products also would be closer to higher income markets.

Bringing Basic Research Home to Roost: Engineering Research Centers

Universities have responded in many different ways to the changing industrial landscape (see Luger and Goldstein (1996), Goldstein and Luger (1997), and Goldstein, Maier, and Luger (1995)). One recent response, mostly by North American universities, has been to establish university-based engineering research centers. Generally, these are organized around technology areas (robotics, biotechnology, advanced materials, etc.). They serve as a conduit for external research funds, as a mechanism for leveraging faculty and graduate student involvement, and as a means to connect in meaningful ways with industry.

Engineering research centers are organized differently in different universities, and provide somewhat different mixes of services. In some cases (as in North Carolina State University's) businesses pay to become members of a center. In return, they get periodic meetings in which expert information is provided, access to working papers, networking opportunities with other industrialists in their field, the right of first refusal on licenses for new technology invented by university-based researchers, and in some instances, access to specialized facilities and equipment.

The sixteen research centers in the North Carolina State University's Engineering School that are currently active involve a large proportion of the College's faculty and students: 158 professors, 436 graduate students, and 87 undergraduates.[8] They also employ dozens of staff members, typically using grant funds.

The Furniture Manufacturing and Management Center has the largest membership, with 66. Many of those are from the Carolinas, reflecting the region's concentration of furniture producers. Other centers, such as the Advanced Electronics Materials Processing Center, draw their members from around the globe. Industrial members help finance the centers' operations. On average, the seven centers with industrial members bring in $661,000 per year in corporate money. The other six centers that receive money from industry average $230,000 per year from that source.

More generally, the centers play an important role in the university's ability to use state money to leverage outside resources. Of a total annual budget for the centers that exceeds $17 million, only $1.3 million is provided directly from the state. A large part of the $1.7 million shown as the University contribution originates in Raleigh, but represents resources the University could have applied to other uses. If we conservatively assume a multiplier of 2.0 -- signifying that every dollar spent by the sixteen centers creates at least another dollar of spending in the economy—we can conclude that state spending leverages more than ten times its value in economic activity.[9]

The economic stimulus from the centers' construction, equipment, and payroll spending, via the multiplier, is only part of the story. The centers' creation of knowledge, and their inventiveness, also are likely to have economic consequences. (Center staff were awarded six patents during 1992-93 alone, and published almost 200 refereed articles.) Those impacts are not as immediate, however, and are likely to be more diffuse spatially.

These centers fill many of the roles specified earlier in this paper. They keep businesses, especially SMEs, informed of rapid technological changes, help businesses in specific sectors network with industry leaders and scholars around the world, provide access to specialized facilities and equipment, and provide an outlet for inventions resulting from university research to reach markets. All these are consistent with the principles I articulated for appropriate policy above.

---

[8] Several faculty members belong to more than one center, so the 158 number overstates the breadth of faculty involvement.

[9] Assume that all of the $1.7 million University appropriation is passed through from the state. Then, the state allocation is $3 million. A budget of $17 million multiplied by 2.0 is 11.3 times the state appropriation.

Thailand: From Mundane Processing to Engineering and Basic Science

Thailand's (as other newly industrializing countries in the region) knowledge sector is recognized to be underdeveloped, relative to the demand for knowledge by the private sector. Industry in Thailand no longer can survive producing only low valued goods with cheap, unskilled labor.

Thai universities are not producing enough scientists and engineers, and many of the best that are produced emigrate. A recent report estimates the shortfall of engineers and scientists to be some 12,000 and 7,000, respectively (Brooker, 1996). In addition, Thai universities generally do not have a tradition of industry-oriented research. To the extent that universities have been involved with industry, it has been to improve basic manufacturing, through the operation of pilot plants or the training of technicians. Those functions are normally performed by technical schools in more advanced countries. There are few examples of patents being produced in Thai university labs.

One way the Thai government is addressing this problem is to develop a system of science parks, related to universities. Some will focus on applied research in particular technology areas (agricultural products, for example). But one, the National Science and Technology Development Agency R&D (NSTDAR&D) Park north of Bangkok, is being modelled after Stanford, Cambridge, and Research Triangle Parks. It has three basic research centers in such areas as biotechnology, microelectronics, and materials, and is designed to accommodate high level research leading to new processes and products.

In light of the conceptual framework developed above, one could say that that approach is inappropriate based on where Thailand is on the development curve. On the other hand, that approach can be seen as a bold attempt to catapult Thailand to a higher position on the curve. As a "demonstration" or "model", the NSTDAR&D Park illustrates several of the principles articulated above. It recognizes Thailand's potential in the global marketplace. That vision comes at a high potential cost, however.

The Sheffield Regional Technopole: Building on an Industrial Tradition

Fifty industrialists and university leaders in Sheffield, England, have formed a technopole around the metals and metals-related materials sector that has historical roots in Sheffield. The mission of that technopole is yet to be defined.

Sheffield was among the world leaders in steel production, beginning in the nineteenth century and through the Second World War. But foreign competition, obsolete plant and equipment, and labor problems all caused employment in that sector to decline dramatically, especially during the recession in the early 1980s. During the past fifteen years the sector has restructured somewhat — with fewer more capital intensive firms producing a high volume of specialty steel and metal products.

The industrial leaders recognize the problems facing the Sheffield economy, however. One is continued high unemployment. Another is the threat of competition from newly developing countries in the speciality metals manufacturing market.

Faced with these realities, the Sheffield technopole is casting about for a strategy to move the region up the development curve. They have defined metals and materials as the focus of the technopole, with plans to assist SMEs in those sectors in yet unspecified ways. The industrial leaders and university officials also are discussing ways to bring knowledge resources to bear on industrial problems.

One interesting observation about the Sheffield situation is that the industrial leaders seem to be locked into a production engineering mentality. They conceive of progress as making existing goods better and more cheaply, rather than to focus on entrepreneurship, new products, and new businesses, possibly in new areas of technology. In short, metals and materials research, in university and industry labs, can be the springboard to a different kind of economy — one that is appropriate for Sheffield's national context. That is an interesting contrast to Thailand, where leaders have taken some aggressive steps to break out of the traditional mould.

Conclusion

Much has been written about the changes in the s been made to link those changes to the development of S&T policies, especially in newly industrializing countries and in regions in advanced industrial countries that are based in traditional industries (the Mon Valley in the U.S., the midlands in the U.K., the Ruhr valley, and so on).

S&T policy is being used to exploit the technological advantages that exist, but also, to help move economies along the development trajectory. That creates some new challenges for policy, including the very high cost of developing a knowledge infrastructure appropriate for the 21st century. It also creates a new type of global competition, with regions in the U.S., the U.K., and other generally advanced countries competing with the NICs in some sectors.

In short, the speed of development in the knowledge economy is such that the old international division of labor can no longer be assumed. On the one hand, regions with well developed knowledge resources are using S&T policy to strengthen further their position as technology leaders, leading to more wealth accumulation. At the same time, countries further down the curve are using S&T policy to catch up with the more developed world, especially with the relatively less developed regions in those countries.

In this paper, I summarized four illustrative examples of S&T policy around the world to show the fit, or lack of fit, between policy and the changing realities. Further work needs to be done along these lines to conduct such policy comparisons more systematically. Throughout the world, policy makers are staggering ahead in order to keep abreast of the rapid changes. In some instances, policies have been well conceived and are consistent with the principles I have outlined. In many other cases, however, policy makers have little basis for the programs they have implemented. That can be costly in real outlay terms, and in terms of lost opportunities.

References

Association of University-Related Research Parks (various years). Data.

Brooker Group, Ltd. and Chula Unisearch (1995). *Higher Education Development Project in Thailand*. ADB Technical Assistance Project T.A. No. 2104-THA. 5 volumes.

Bruhat, Thierry (1995). Presentation to Conference "RTD Potential in the Mezzogiorno of Italy: The Role of Science Parks in the European Perspective," Consorzio Mario Negri Sud, Centro di Recerche Farmacologiche e Biomediche. S. Maria Imbaro, September 1995.

Cobb, Clifford, Ted Halstaed and Jonathan Rowe (1995). "If the GDP is Up, Why is America Down?" *The Atlantic Monthly*, October: 59-79.

Fiedler, H. (1992). *Innovation Centres in Central and Eastern Europe*. Berlin: Weidler Buchverlag.

Fiedler, H. (1994). "The Role of Science and Technology Parks in Regional Economic Development." In K. Gonda, et al. (eds.). *Regionalization of Science and Technology Resources in the Context of Globalization.* Sangyo Chosakai, Japan: Industrial Research Center: 215-235.

Fusi, D. (1991). "Major New Sites for Science Continue to Spring Up Around the World." *Site Selection.* June: 610-615.

Goldstein, Harvey and Michael Luger. (1997). "The Economic and Business Development Impacts of Universities." In Marvin Peterson and David Dill, eds. *Planning Strategies for the New Millenium: Redirecting, Reorganizing and Renewing Postsecondary Education*. New York: Josey-Bass.

Goldstein, Harvey, Gunther Maier, and Michael Luger. (1995). "Universities as Instruments of Business and Economic Development." In D. D. Dill and B. Sporn, eds *Emerging Patterns of Social Demand and University Reform: Through a Glass Darkly*. Oxford: Pergamon Press

Jaffe, A., M. Tratjenberg and R. Henderson (1992). "Geographic Localization of Knowledge Spillovers, as Evidenced by Patent Citations." *Quarterly Journal of Economics*.

Japan Small Business Research Institute (1995). *Entrepreneurism in Small Businesses: Summary*. Kanagawa Prefecture, April.

Kruit (1995), Presentation to Conference "RTD Potential in the Mezzogiorno of Italy: The Role of Science Parks in the European Perspective," Consorzio Mario Negri Sud, Centro di Recerche Farmacologiche e Biomediche. S. Maria Imbaro, September.

Luger, Michael I. (1989). Private Sector Options for Solid Waste Disposal: A Background Survey for Application in Nigeria. INURD WP#10. Washington, DC: The World Bank, December. 39 pp.

Luger, Michael I. and Harvey Goldstein (1991). *Technology in the Garden: Research Parks and Regional Economic Development.* Chapel Hill, NC: University of North Carolina Press.

Luger, Michael I. (1987). "State Subsidies for Industrial Development: Program Mix and Policy Effectiveness." In John M. Quigley, editor. *Perspectives on Local Public Finance and Public Policy*. Greenwich, CT: JAI Press. Pp. 29-61

Luger, Michael I. (1996). "The Appropriateness of STP Models for Regions with Different Economic Development Capacities and Needs." In G. de Gaetano and H. Logue, eds., *RTP Potential in the Mezzogiorno of Italy: The Role of Science Parks in a European Perspective.* Luxembourg: Office for Official Publications of the European Communities. Pages 87-103.

Luger, Michael I. and Harvey Goldstein (1997). "Public Universities and Private Jobs." In Richard Bingham and Robert Mier, eds., *Universities and Economic Development*. Beverly Hills, CA: Sage Publications

Markusen, Ann R. (1985). *Profit Cycles, Oligopoly, and Regional Development.* Cambridge, MA: MIT Press.

Marinazzo, Mario (1995). Presentation to Conference "RTD Potential in the Mezzogiorno of Italy: The Role of Science Parks in the European Perspective," Consorzio Mario Negri Sud, Centro di Recerche Farmacologiche e Biomediche. S. Maria Imbaro, September

Massey, Doreen, Paul Quintas and David Wield (1992). *High-Tech Fantasies: Science Parks in Society, Science and Space.* London and New York: Routledge.

National Institute of Science and Technology Policy (1994). Survey results reported in Oyama, et al.

Orr, Barry E. (1988). "Science Parks in the Asia-Pacific: Is There a Model?" Address to International Science Park and Innovation Conference, Singapore, October.

Orr, B.E. (1994). "Present Status of Development of Science and Technology Parks in the World." Paper presented at Seminar on Development Strategies of S&T Industrial Parks in Asia and the Pacific, May 23-24.

Osborne, David E. (1988). *Laboratories of Democracy*. Boston, Mass. : Harvard Business School Press

Oyama, Y., T. Yamammoto, J. Yoshizawa, and K. Gonda (1995). "Comparative Studies on S&T Parks for Regional Innovation Throughout the World." Paper presented at NISTEP Conference on Regional Science and Development Policy, April.

Porter, Michael E. (1990). *The Competitive Advantage of Nations*. New York : Free Press

Rostow, W.W. (1960). *The Stages of Economic Growth: A Non-Communist Manifesto.* New York: Cambridge University Press.

Science Park Adminsitration (1993). Hsinchu Science Based Industrial Park Annual Report.

Science Park Adminsitration (1991). Hsinchu Science Based Industrial Park Annual Report.

Shive, Chi (1992). "The Economics of Establishing "ROCs" and "PRCs" in Taiwan." Presented at 16th Joint Conference of USA-ROC and ROC-USA Economic Councils, December.

Shive, Chi (1994a). "Regional Operations Center and the ROC Economy in the 1990s." *Industry of Free China LXXXI*, 2, February: 43-54.

Shive, Chi (1994b). "Taiwan's Economic Restructuring in the 1980s and its New Role in the Asian Pacific." Manuscript.

Shoupeng, D. (1994). "The Innovation in New High-Tech Development Zones of China and Micro-Management of Chinese Government." In K. Gonda, et al. (eds). *Regionalization of Science and Technology Resources in the Context of Globalization.* Sangyo Chosakai, Japan: Industrial Research Center: 109-115

Vernon, Raymond (1979). "The Profit Cycle Hypothesis in an International Environment." *Oxford Bulletin of Economics and Statistics 41*, 4: 255-67.

Wall Street Journal (1995). "World Bank Ranking of Nations Puts Australia on Top, U.S. 12th." September 18: 2.

“The policy for regional technological development in Japan”

by Mr. M. Obara, Agency of Industrial S&T (AIST), Tokyo, Japan

1. Introduction

Ladies and gentlemen,

It is an honor and a pleasure for me to give a presentation at this session.

Today I will talk about the present condition of Japan’s political measures for promoting local science and technology development and the future direction of such measures. In particular, I will focus on those measures which are mainly carried out by the Agency of Industrial Science and Technology (AIST) of the Ministry of International Trade and Industry (MITI) for the purpose of enhancing research and development (R&D) technologies involving regional private enterprises. This is because there will be a discussion about various aspects of the role of industry in regional R&D during this session.

2. Background concerning political measures for promoting regional technology development

Before I begin to explain about this subject, I would like to briefly comment on three trends that Japan’s science and technology policy has exhibited in recent years as background concerning political measures for promoting regional technology development. To understand why such political measures are implemented and what direction they will take in the future, an understanding of three points is essential. These three points are:

1. The position of the Science and Technology Basic Plan and the role of the measures to promote local science and technology included in the plan

- The Science and Technology Basic Plan, which was established in July of 1996, is the government’s basic implementation plan to extend its policy for science and technology over the next five years. It advocates the necessity of increasing the government’s budget to promote science and technology and identifies seven political subjects to implement synthetic and systematic political measures.
- The promotion of local science and technology is one of the seven important political subjects, and there are four specific measures to attain such political subjects. These four measures are:

  i) The government will amplify support to arrange characteristic science and technology facilities to contribute to local life and to respond to local society’s own needs.

  ii) In order to promote the spread of R&D results which are based on local needs and characteristics, and to make them feasible, the promotion of collaboration and interchange among regional industries, academia and government is important. Therefore, the government will establish and consolidate various R&D systems which regional industries, academia and government will participate in.

iii) The government will increase its assistance for R&D and advisory activities which are carried out by public research institutes to develop local industries.

iv) Governmental R&D functions will be extended to the regional level.

2. The background of preparing the Science and Technology Basic Plan and positioning the promotion of local science and technology as an important subject in the plan

- The plan reflects Japan's recent trends of economic society. Therefore, the background of the plan is common to the entire nation and local areas. The following three considerations are emphasized.

  i) It is worrisome that we will face industrial cavitation, declining social vigor and a lower quality of life due to very severe international economic competition brought about by economic globalization and an increase in the number of aged people in Japan. To respond to such worries and to attain vigor and a better life, it is expected that science and technology which can create new industry and expand economic frontiers will advance. Since it is time that each region faced world economic trends because of economic globalization, it seems that the worry about industry cavitation is increasing from that of the past. Therefore, it is essential to let the promotion of local science and technology contribute to the evolution of local societies.

  ii) One of the ultimate purposes of science and technology is to meet the needs of a society and to provide a better life. So, science and technology should be promoted from this viewpoint, as the government's plan points out. Since people's needs are varied, the necessity of promoting technology development linked with local society's needs is increasing for the purpose of understanding such needs properly.

  iii) It is thought that promoting local science and technology based on the potentiality, character and needs of local society will contribute to enhancing and diversifying the entire nation's science and technology in the context of raising local society's autonomy and its wrestling with evolving characteristics in an expanding market economy.

- Although the promotion of local science and technology has been promoted as an industrial policy and a small enterprise policy from the viewpoint of balanced development of the entire nation, it should also be promoted as a science and technology policy in the context of such a background as mentioned before.

(3) Viewpoints that AIST focused on to take specific measures for the promotion of local science and technology

- One of the ultimate purposes of promoting science and technology focuses on contributing to a better life for people by utilizing technologies by either creating new industry or providing better products and services to meet the needs of society. This means that it is necessary to make much of this ultimate purpose even in the process of promoting basic R&D.

- In a market driven economy, private enterprises should promote utilization of science and technology autonomously. From this viewpoint, AIST attaches importance to private sector involvement, such as cooperation among industry, academia and government when AIST takes political measures to promote technology R&D. Therefore, in order to attain private sector involvement efficiently, not only privatizing the nation's R&D results but also establishing a system that allows private enterprises to participate in the phase of planning an R&D project are essential.

3. Regional policy of AIST

AIST has established 15 national laboratories to promote development in fields which AIST has jurisdiction over. There are eight laboratories for special development fields such as bio-science, electrical technology and mechanical engineering. The other seven laboratories, which have been located in different regions, have been established for the purpose of promoting R&D conducted in each region.

4. Regional research institutes of AIST

(1) Research institutes of AIST have been established in different regions to enhance regional industry technology. Each regional research institute implements R&D on technological subjects which are considered essential in the region so that regional industrial technology is enhanced.

Examples of regional research institute activities are outlined below.

- Hokkaido National Industrial Research Institute: This institute is located at Sapporo City in Hokkaido, the coldest geographic area in Japan. Therefore, it has mainly studied cryogenic engineering and biochemical technology. Because Hokkaido used to have many coal mines, the institute has studied coal liquefaction and gasification technologies.
- National Industrial Research Institute in Nagoya: This institute has mainly studied ceramic technology since Nagoya is traditionally a place of ceramic industry. The institute is a representative laboratory in the field of ceramic technology in Japan.
- Chugoku National Industrial Research Institute: This institute has been contributing to studies directed towards solving pollution problems in the Seto-inland sea, the most polluted area in Japan.

Each of the above institutes has implemented many studies on broad-based industrial technologies in addition to the main fields described.

(2) These regional institutes have also implemented technology guidance and consultation for small enterprises as well as joint research with enterprises, and their activities contribute to enhancing local enterprise technologies.

Reference: The number of participants in FY1994 activities was as follows:

- technology guidance 175
- technology consultation 3,097

(Problems)

The number of researchers is limited and the budget for R&D is not sufficient. Although national laboratories are expected to generate R&D results for the entire world, this is a subjective issue and it is hard to balance local R&D with worldwide R&D. To be specific, the allocation of researchers and R&D themes is a dilemma which needs to be considered and addressed.

(3) In particular, AIST recommends joint research systems with local enterprises concerning advanced technologies which are commonly required by many local enterprises. Therefore, AIST provides a special R&D budget to such joint research.

5. Small and medium-sized (leading class) enterprise type local technology research system

Concerning the joint research system for small and medium-sized enterprises, MITI's regional institutes conduct R&D on subjects necessary for the development of local industry, and they contribute to technological development of local small and medium-sized enterprises through cooperation with local small and medium-sized enterprises and local public research institutes. Local national institutes' joint research projects satisfying the above purpose receive special research funds from AIST (for one theme, 40 million yen/year). Enterprises, counterparts in joint research, must pay their own expenses. At present, in eight regions of Japan, eight research institutes (seven local institutes and the Mechanical Engineering Laboratory) are conducting eight research projects (the term of research is about 5 years).

(Examples of projects)

a. "Advanced Utilization Technology of Unused Agricultural and Marine Products"
(Hokkaido area, Hokkaido National Industrial Research Institute)

- Hokkaido is Japan's largest agricultural area and is particularly known for potato production.
- The purpose of this project is to develop technology to extract chemical resources from potatoes by developing processes related to the fermentation, separation and refining of potatoes.
- The results of this project will lead to a new way to utilize agricultural and marine products for industrial use.
- Many local food industries and agricultural organizations participate in this project.

b. "Fine Ceramics Molding"
(Tyubu area, National Industrial Research Institute of Nagoya)

- The Nagoya area has traditionally been a place of ceramic production.
- The purpose of this project is to enable traditional china molding technology to apply advanced fine ceramic molding technology. The difference between conventional molding technology and advanced ceramic molding technology is that in the process of molding fine ceramics, a particular chemical material is used to combine particles and in the process of conventional molding, ordinary water is used.

- The results of this project will make it easy for conventional china enterprises to extend their business into fine ceramic industry.
- Many local china enterprises participate in this project.

In addition, advanced R&D functions of regional research institutes are utilized to implement world leading R&D projects.

6. Local advanced large-scale project using local R&D resources

Local advanced research facilities and personnel are utilized to conduct global leading R&D. In relation to the implementation of research, AIST's regional institutes and private enterprises will establish closer relations. For the R&D budget of private enterprises, NEDO, MITI's implementing agency for industrial technology development, receives governmental funds and entrusts research to private enterprises. At present, seven research projects are in progress.

(Examples of projects)

a. "Advanced Combustion Science using Microgravity"
(Hokkaido National Industrial Research Institute)
By using an 710-meter drop shaft in Hokkaido, NEDO and NASA of the United States are working together to conduct research to elucidate combustion mechanisms in space using ten second microgravity experiments.

b. "Advanced Manufacturing Technology of Metal with a High Melting Point"
(Chugoku National Industrial Research Institute)
The R&D of niobium alloy, which has a higher thermal resistance than existing heat-resistant metal, will be conducted for use as gas turbine material. The facilities and equipment of the Japan Ultra-high Temperature Materials Research Center will be used for this research.

7. Basic Research Facility Development Program

The Basic Research Facility Development Program is a necessary program for the advancement of R&D. The purpose of the program is to provide services which enable both domestic and overseas researchers to use facilities which are difficult for private enterprises to establish themselves by establishing research facility development corporations through the cooperation of private enterprises and local governments. Since 1989, a total of five research facility development corporations have been established, and they each began offering services to researchers in 1992 after the installation of equipment and necessary facilities.

> Note: As for the cost of constructing and equipping the research facilities, half of the cost has been met through investment and the other half by loans. Two-thirds of the investment has been financed by the national government through NEDO, with the rest financed by local governments and private enterprises.

(Examples)

(1) Japan Microgravity Center (JAMIC)

JAMIC utilized an abandoned mining shaft and created a drop shaft of 710 meters. It has the highest performance ability in the world with experiment facilities capable of a microgravity environment for ten seconds. In recent years, JAMIC has conducted about 500 drop fall experiments a year. JAMIC is actively used for domestic research projects in the field of combustion, materials and physical properties, and also by NASA researchers for combustion technology experiments in microgravity environment.

(2) Ion Engineering Center Corporation (IECO)

IEDO focuses its attention on large ion beam deposition and costly analysis and evaluation equipment to develop the semiconductor and new materials industries. It carries out R&D on electronic materials and surface reform of materials with emphasis on the electronics industry (Matsushita, Mitsubishi Electric, Sumitomo Electronics, etc.) located near Osaka.

(3) Applied Laser Engineering Center (ALEC)

ALEC facilitates advanced high output lasers necessary for creating metal processes and metal reforming in Niigata (Nagaoka-city), where metal processing is extensively carried out. It will be widely used for national projects on new material development and local government's training programs for small and medium-sized enterprise managers.

- R&D Grant Program for Local Enterprises

In order to support the R&D of local private enterprises, AIST established the R&D Grant Program using local international trade and industry departments in 1996. As for R&D of private enterprises, it judges the meaning of R&D based on a local point of view and not by the general evaluation method at the national level (it selected four projects in FY1996). AIST has made a request to the Ministry of Finance (MOF) to increase this support system budget in FY1997.

"Local regional integration of globally accessed technologies"

by Dr. J. Viana Baptista, Instituto de Ciencia Aplicada e Tecnologia, Lisboa, Portugal

Having been invited by the Conference Director to address the audience as key-speaker of Session Ib I must thank the Organization for this opportunity to express some personal opinions and suggest a few reflections on the themes.

In this Session two main themes are suggested, the first being "Regional integration of industry and technology" and the second concerning "Regional industry and global dynamics". It is easy to recognize the very ambitious nature of such themes while we must take advantage of a certain number of questions included in the working documents. Such questions should certainly be considered as suggestions for reflection by the participants, since it is hard to believe we can find clear answers or arrive to conclusions.

I believe most of us may accept the statement expressed in the working document that regional development requires strengthening of industrial activities and improving their relation with technology; although we must recognize the importance of a diversity of enabling factors others than technology, such as business services, financial markets, logistics, etc.

Before trying to discuss how to implement measures for improving the situation we must try to obtain a better understanding of some basic concepts, such as those pertaining to regions, regional development, regional industries and regional systems of innovation. A first positive step may be to establish a common understanding of region identified for the purpose of this Conference as a regional system of industrial activities upon which a regional system of innovation may be developed. This means that regional diversities and specific characteristics of regional industries must be taken into account.

The concept of a regional system of innovation implies that RTD (and innovation) is considered as an important factor to promote industrial and economic development. Without denying the importance of such factors we must question ourselves about the real effect of programs oriented to improve the situation and their impact in supporting regions whose development lags behind, like for example those of Southern Europe and peripheral regions. In this respect I must say that many industrialists consulted by IRDAC (*) on several occasions have clearly expressed their concern for the relative importance of other conditioning factors for industrial development, technology being just one tool for improving the competitiveness.

If we try to reflect about the concept of regional industrial development we must consider the ever increasing importance of globalization of trade, technology and knowledge. Most industrial activities nowadays are organized around a complex and vast network of suppliers and subcontractors for components and services including many specific technologies. This means the very concept of regional industry is under challenge and eventually about to be replaced by a system of human skills able to organize the transfer of technologies and the negotiation of subcontracts. And when we refer to technologies, knowledge and skills we must consider not only those required to the end product but also and specially those needed to maintain and develop such a complex and dynamic system continuously driven by

(*) IRDAC - Industrial Research and Development Advisory Committee of EC competitiveness. In summary the question to be addressed is the possibility of clustering within a region the elements necessary for industrial development.

Clustering convergent technologies may be the result of many different factors. We may say that tradition has played an important role in regional industrial development in those times when entrepreneurial initiative was enough to assemble human skills around natural resources and local markets. Eventually some industrial regions survived and developed on account of the clear vision of new generations of entrepreneurs promoting the up-dating of technologies associate with new models of trade, including technology transfers and licensing agreements. Many successful developments were produced by encouraging, sponsoring or contracting research and technological development programs with local or regional laboratories and universities. This is a traditional model of regional industry leading the development of regional technology. A similar model is the one produced by a foreign investment initiative, decided upon an evaluation of comparative advantages granted by regional authorities, as a result of which local or nearby ancillary industries try to develop new technologies in order to obtain certifications necessary to qualify themselves as subcontractors or suppliers for the newly established industry.

In opposition to such models you may eventually quote a few examples of situations where universities or laboratories have been established in a particular region to develop technology and know-how with no relation to the existing industries. Although much less frequent, such a model may have produced an attraction effect upon industries, but I believe it is rather difficult to make an ex-ante evaluation valid for justifying an important public investment expecting to obtain a significant return in terms of regional development. Such an evaluation implies understanding the process of decision for industrial location. As you know there are abundant studies on this matter covering the evaluation of the relative value of investment conditions either natural or created upon the initiative of public authorities. Having been myself involved in this kind of exercise, I must say that in what concerns European regions the availability of technology in a region is not considered as a paramount factor since transfer of technologies, training methods and mobility of human resources are relatively easy.

The role played by transnational corporations in expanding and dispersing their RTD activities within their own corporate system has to be recognized as very significant. Transferring technologies to affiliates as part of a foreign investment contract or even through non-equity arrangements is becoming a common practice which improves the technological environment of the host region. To illustrate the importance of those operations it is worthwhile to note that 75 to 80 per cent of global civilian R&D expenditures at world level is concentrated within transnational corporations systems. These corporations have, among other favourable conditions, the ability to organize and deploy their technological assets world-wide and they are much better equipped to commercialize innovations over global markets than universities or research institutions. Advances in communications and information technologies represent a decisive contribution to the division and integration of RTD activities developed in different regions.

Liberalization of trade and investment together with strengthening of intellectual property rights are also positive conditions to encourage dispersion of RTD activities. The impact of this changes upon a regional system of innovation depends to a large extent on its indigenous capabilities and on the economic and policy environment. It is easy to recognize that the more advanced regions are in better position to attract industries with higher technological contents which will reinforce the regional capacity, to the detriment of less advanced regions.

Trying to correct this natural tendency is a difficult task requiring a large spectrum of policy measures such as supporting universities, facilitating housing and mobility, encouraging the settlement of ancillary industries, financial services, technological parks, etc.. The value of such measures to promote what we may call a "knowledge lead" development model is naturally uncertain and modest when compared with an "industry lead" model, because of the strong tendency of industrial corporations to locate their technological development centers close to manufacturing sites.

I believe there is a large consensus about the impossibility to isolate a region self-sustained by its own industrial activity and technological development. There is an obvious need to access technologies and markets on a transnational dimension which means that in fact we must talk about a system of exchanges instead of trying to devise how to integrate locally technical capacities generated elsewhere. We may eventually consider the intensity of technological transactions as an appropriate yard-stick for evaluating regional development. On the other hand you may argue that such measures will not encourage the establishment of local RTD units. There is no obvious answer to such an apparent dilemma, the conclusion being that an appropriate balance is to be found according with the stage of development of each region. Each stage of development has an associated critical mass which determines the success of local initiatives oriented for the promotion of endogenous technological developments. The role of public authorities in encouraging or sponsoring such developments is certainly important but should not be overemphasized. In fact the free initiative of entrepreneurs can not be replaced by the action of any public authority and the willingness to take risks in search of an increased competitiveness depends from many factors not necessarily related with technology.

Finally allow me to make a remark on the difficulty to make comparisons specially when we try to confront experiences of non-European countries. The first difficulty emerges from strong differences in what concerns business climate and cultural aspects. The second difficulty, (or rather a danger of analysis) is the impossibility to reproduce all the conditions that have been present in a successful experience at a certain occasion.

As you may have noticed I was not able to produce any answers. Most probably I have made some contribution to increase doubts. Maybe I have encouraged you to discuss some aspect and eventually contributed to promoting a better understanding of these problems. We must salute the difficulties in dealing with the proposed matter, having in mind those difficulties are the price for preserving one of the highest values of Europe, which is free-initiative and willingness to put technical advances at the service of social progress.

“Roundtable contribution”

by Dr R. Behrendt, Ministry for Economic Affairs, Magdeburg, Germany

Global comparative analysis of innovative regional systems and presentation of concrete examples of networking and strategy creation between universities and business in the regions

The Association of Traditional Industrial Regions of Europe (RETI) represents the industrial and technological regions of Europe that have common problems and interests and a shared experience in technological processing. RETI concentrates mainly on regional policy issues and exerting an influence on the industrial changes taking place in Europe. There is a special network within RETI, known as RETInet, which deals with technological transfer and the promotion of innovation.

RETInet members support the regional processes of innovation through cooperation and the exchange of experience and information between the authorities, research institutions and business both within and between regions. Regional technology planning is an important instrument for this purpose.

This cooperation shows how the access needed by regional companies to new technologies and markets to enable them to become more competitive can be made easier.

The role of industry in regional technological development

Remaining competitive is always the main challenge facing every company and economy. Although the specific nature of how this should be done may vary as circumstances change, the challenge is always there.

Companies, businesses and society in the industrialized countries of Europe must come to grips with the worldwide processes of economic and technological change:

- a society based on industrial production is giving way to a society based on services, knowledge and information,
- production, knowledge and capital are becoming increasingly mobile and global,
- in many sectors, distance is no longer a problem thanks to the new technologies.

The situation is characterized by the fact that:

- industrial research has continued to decline in nearly all fields since 1992,
- large companies are increasingly moving their research and development abroad,
- simply turning research into marketable products is no longer enough, and
- small and medium-sized companies are suffering from problems of funding: there is too little private risk capital available.

This poses two challenges:

- maintaining regional competitiveness through cooperation between companies, research institutions and the authorities, and
- ensuring the technologies on offer around the world are accessible and usable.

For research and development to be economically effective, it must always be targeted on goals and values. In the final instance, it is industrial performance and innovative companies that determine what research regional establishments will be asked to do.

The companies in a particular branch of industry or region, the structure of the economic and social activities in a region and society elaborate systems of innovation which have their own extremely complicated dynamics.

Innovation may be either stimulated or stifled by factors such as the quality of education, the legal and tax systems, the competitive situation, a company's partners, the legal situation with regard to patents and intellectual property and the structure of government research and services. It is this which produces the regional differences in technological development and creates the need for a framework of support.

As structures change, so does the industrial and social potential for innovation. Measures must therefore be in place to maintain, stabilize and increase competitiveness durng these changes. The types of research needed change and research establishments must be able to react accordingly.

The changes now taking place in the new German *Länder* have thrown up additional, hitherto unseen and especially difficult problems in all areas of the economy and society.

These are due to:

- the sudden transition from a centrally planned economy and administration to a market economy,
- the sudden, almost total loss of existing markets, which were chiefly in Eastern Europe,
- the privatization of companies throughout the entire region, and
- the lack of business capital.

Industrial research is made particularly difficult by:

- the far-reaching cuts made in industry's research capacity (the number of people employed in research and development by businesses in Saxony-Anhalt fell by 75% between 1990 and 1994),
- the very low capital limit of companies, making it necessary to subsidize innovation; there are very few companies making rapid advances in innovation,
- the almost total absence of any large companies: 98% of the industrial firms are SMEs with far less than 500 staff; these, then, are the people responsible for industrial research,
- the decline in the importance of mechanical engineering and chemicals, traditionally the main research-intensive industries in Saxony-Anhalt, and,
- the lack of the "upward pull" normally exerted by large companies on innovative small or medium-sized firms.

The restructuring of firms as well as closures and the changes made in the public research sector (universities and institutes) have drastically cut innovation potential. There are now gaps in the innovation process and the flow of information needed for innovation has been interrupted. There is little demand for application-oriented research or development of totally new products due to the lack of qualitative and quantitative potential on the part of project developers.

There are about 600 innovative companies in Saxony-Anhalt. Innovation by companies in Saxony-Anhalt (in 1995) was as follows:

Innovation from scratch	15%
Improvements to procedures and products	57%
Redevelopments	25%
Projects now obsolete	3%

About 11% of manufacturing companies in the technology sector carry out their own research and development and therefore have their own sources of innovation, but only 10% of such companies which also provide services. Fewer than 1% of them are involved in European research, development and demonstration projects or claim to have any need for them.

The challenge therefore is to boost the demand for research and development and thereby to extend research throughout the regions.

The capacity for innovation will increase if there is adequate research potential, proper funding and the potential for innovation at regional and supraregional level.

Regional technological and innovation schemes, such as those promoted by the European Commission, are good ways of bringing together and concentrating manpower and resources on key sectors of the economy.

The research capacity available and the types of innovation needed will be analyzed in order to

- define strategic development targets and locate the most promising areas of technology and the key areas on which to focus and
- to identify the tool, methods and agreements that will be needed.

This will enable a framework for innovation to be laid down so as to promote development in the growth sectors of industry in particular.

Financial assistance for innovative projects in Saxony-Anhalt is available in the form of proportionate funding, low-interest loans and, more recently, equity and risk capital.

There are skilled advisory and innovation services which can help translate the capacity for innovation into actual innovation more easily.

There is a network of facilities for technology transfer and the promotion of innovation which, together with the technology transfer centres of the universities and technical high schools, cover businesses throughout the region (this network was described at the final meeting of the Community-level conference to discuss the European Commission's Green Paper on Innovation as being exemplary).

Technology schemes bring together the forces for making rapid progress in areas of technology where innovation is especially important, such as the "Telematics Initiative" and the projects now running in the field of biotechnology.

International cooperation within the European Union and worldwide is essential in order to ensure that businesses remain competitive.

The regions are fully capable of strengthening the innovative potential of small and medium-sized companies and finding ways to fight the trend towards disintegration of the industrial fabric. Participation in technology schemes in Europe means participating in international associations.

***Questions and comments:**

DR. KOMNINOS' SPEECH	
One of the key issues by Prof. Komninos was that only 1% of Structural Funds was directed towards RTD in the peripheral regions. Another typical element relates to the size of companies since most of them are SMEs. I wonder if a solution to ameliorate the situation in peripheral regions would be to increase networking and collaboration between industries in increasing new technologies.	
PROF. VIANA BAPTISTA´S SPEECH:	
Portugal together with the European Community is now in its 3rd programme with substantial resources in through *Ciencia* concerning improvement of S&T infrastructure - part of it for restoring and helping industry - and now you have a *Praxis* programme for training. Are you sceptical about those?	No, I am not sceptical at all; I am proposing to put in exact place the importance of technology ahead of industry.