Beilage Rednordner
Ker. 24/3

International Conference

THE ROLE OF UNIVERSITIES IN THE REGION

Kosice 11. and 12. November 1992

A Three Level Model of Research and Delvelopment - The Dortmund Case -

Prof. Dr. Detlef Müller-Böling
University of Dortmund

1. The Challenge

"Corresponding to the needs and requirements of a modern international society the decision was taken to build a new cultural metropolis, to be named Cultural, Scientific and Research Metropolis.

We are living in an era of historical change. The planned new cultural metropolis has been developed with the aim of improving education in the field of basic scientific research on the basis of a new culture which will bring together the arts, sciences and technology. This will create the framework within which a link between basic scientific research or basic sciences and applied technology can be realized."1

With this objective in mind and the will to achieve a "bigger contribution for peace and prosperity in the world in the 21st century", the Kansai-region with the towns Nara, Osaka and Kyoto in Japan has created a totally new and from the point of view of size powerful infrastructure of sciences since the mid eighties. In an area of 3000 hectars including 12 districts a number of scientific institutions are being built and planned with the most diverse sponsorships and forms of financing including the university itself and market research institutes.

Something similar is taking shape in the Taedok Science Town in Taejong, South Korea. Today, 19 institutions with more than 8,000 staff have already been created around the Chungnam National University. 33 more institutions are planned with again 8000 employees. Here too the different institutions are either privately or state financed or by a combination of both.

In both cases an extremely multiplex and densly linked scientific and entrepreneurial network with high resource potential in structures of public and private finance has been created.It represents tough competition and a challenge to the European economies. Especially from this point of view the question has to be asked, what a scientific environment which encourages innovation should look like in order to be entrepreneurial successful.

---

1) Proposition paper for the construction of a cultural metropolis in the Kansai-region, Japan. The following explanations are based on a visit to Korea and Japan in September 1990. Informations of working papers and prospects have been included.

2. A model of 3 levels explaining a scientific environment

The forthcoming paper follows two synergetic point of views, the view of the rektor of an university as science manager and second the view of a business management scientist with the main subject in entrepreneurial research and teaching. In both views I see, that in south-east Asia as well as here in Europe research and development, that means the basis for entrepreneurial an economic innovation is being done on 3 levels, whereas the transition is fluid.

Level of Assignment		Organization
3	commercial research and development	Large-Scale Enterprises Business-Start-Ups Technology-Park
2	cooperative research and development with economic practice	Fraunhofer-Institutes R&D Corporation at UniDo
1	basic oriented research and development	Universities Max-Planck-Institutes, Blaue-Liste-Institutes

The first level is characterized by the fact that research and development take place without any influences or inter-dependencies. According to Article 5 of the German Constitution research and teaching are free from outside interferences. This implies independence for scientists and scholars who are answerable only to their own conscience and to basic norms of the society. Traditionally the home base for this level in Germany has been universities, and also since the mid 60's institutions for large-scale research, independent institutes for research (the blue list) and Max-Planck institutes. The financing of this research is provided in most cases by government on the basis of fixed budgets for the institutions supplemented by a negligible amount financed by outside sponsorship.

The second level is characterized by applications oriented but not directly product oriented research and development in close relationship with practical concerns. At this point pilot systems or prototypes originate, which will be developed further to marketable products through organizational units of the third level with additional development expenses. This can only happen under the condition of effective practice: in order not to solve the wrong problems. Large-scale enterprises, especially international corporations have already established research and development facilities, without a direct link to product developments. Often cooperations arise between the economic and scientific world, which take place in the university itself or in small institutes (An-Institute) outside the university according to their dimensions.

The institutes of the Frauenhofer-Gesellschaft can be considered as the only existing supporting institution for this kind of scientific environment. They are financed partly publicly and partly private. The FHG-institutes perform excellent work, but are not capable of exploiting all the potential of the second level. On the one hand they are not numerous enough and on the other hand they are only designed for individual university professors. Due to this deficit at the moment we are creating an organization for research and development at the University of Dortmund.

On the third level the commercialization of research and development takes place. Plans for research and development on this level are determined mainly through actual and future marketing prospects. The output at this level is marketable products which will have a high level of innovation. Supporting organizations of this part of the scientific environment are on the one hand the research and development departments of enterprises and on the other hand newly-established businesses. University professors may be directly or indirectly involved through their own scientific work and knowledge transmitted through graduates or former collaborators. This part of research and development is being financed mainly through private capital from budgets belonging to the enterprise, equity interest, loan capital or venture capital within the newly-established enterprises.

This is an ideal model. The transition between these three levels is fluid; because it is very difficult to distinguish clearly between a prototype and a product, in the same way as basis and applied research cannot be separated for ever. Therefore it is even more important to make these transitions possible from the organizational part and to encourage them. It is decisive for the innovation success of an economy and thus for the succes of the single enterprise, how successful the interaction on the three levels can be organized, in order to achieve the most effective path from basis-oriented research and development to a marketable product. This is not a one-way transfer. Rather, mutual impulses and communication processes have to provide an effective teamwork. In the next part of my presentation I would like to explain what the innovative scientific environment looks like in Dortmund.

3. First level of the scientific environment: University of Dortmund and WINDo e.V.

The University of Dortmund was founded in 1968 and has 310 professors, around 2,400 scientific and non-scientific collaboraters and 22,000 students. The University has a science-engineering focus through the Faculties of Mathematics, Physics, Chemistry, Computer Science and Statistics and also through the Faculties of Chemical Engineering, Mechanical Engineering, Electrical Engineering and Construction. The Faculties of Spatial Planning and Economic and Social Studies provide the University with a socio-economic focus. Apart from these there are five more faculties for the education of teachers for the primary and secondary level education.

The university has a large number of employees financed by third-party funds compared to the number of employees appearing in the offical budget. In the scientific field they amount to 40% of all employed. The volume of third-party funds from outside the university in 1991 amounted to around 59 Mio DM, 12 percent of which came from the private sector, 88 percent from public promotion sources, which are distributed according to peer group reviews.

Looking at the 1.068 scientific collaborators each one would gain an average amount of 55.000 DM from third-party funds.3) Thus the University of Dortmund belongs to the very successful competitors for third-party funds among german universities.

In the city of Dortmund around 25 other non-profit-making scientific institutions have joined together to form a working party of scientific institutions of called the Dortmund "Arbeitsgemeinschaft Wissenschaftlicher Institutionen Dortmund e.V. (WINDO). The working group aims to coordinate events, symposiums and congresses as well as furthering public relations with a view marketing the scientific location of Dortmund.

4. Second level of the scientific environment: Research and Development Corporation at the University of Dortmund

At Dortmund there is located an Fraunhofer Institute für Materialfluß und Logistik, directed by two collegues of the faculty of mechanical engineering of the University of Dortmund. The institute has nearly 200 employees with a turnover of round about 30 Mio. DM, 70 % of this supported by funds. This is a very high rate related to other Fraunhofer-Insitutes. Nevertheless I feel deficits at the second level of the scientific environment - in which research and development should occur in close cooperation with practice, without resulting in marketable products. Therefore we have to be made good by entirely new organizational forms. These will have to go beyond existing dimensions of cooperation. Therefore I would propose to have research and development corporations at German universities, which will develop extra R&D-capacities and will fundamentally increase the scientific potential around universities.

We are currently involved in establishing such a corporation for the University of Dortmund. The basis is three initiatives of over 30 university professors from Dortmund from the most diverse disciplines, who have joined in single groups.

* the Dortmund Computer Science Centre (ICD) e.V., a union of professors of the Faculty of Computer Science with objectives in the area of software technology and microelectronics,

* the Dortmund Initiative for "Rechnerintegrierter Fertigung (RIF)", an interdisciplinary union of university professors from Mechanical Engineering, Electrical Engineering, Computer Science and Economic Sciences with the aim to consider the entire life cycle of a product starting from the development and production, as well as

* the Dortmund Centre for Expert Systems (ZEDO) e.V., an interdisciplinary union in the area of artifical intelligence with university professors from the areas of Computer Science, Statistics, Mechanical Engineering, Chemical Engineering, Construction, Electrical Engineering and Economic Sciences.

4.1. Tasks

The Research and Development Corporation (FuE-Gesellschaft) at the University of Dortmund has to be viewed as an umbrella institution for the three initiatives mentioned above. It fulfils services functions mainly in following areas:

- Marketing

* Elaboration of a long-term strategic target
* Market-analysis and -prognosis for scientific areas and for target groups
* Support during the acquisition of projects
* Scientific journalistic preparation of research results
* Establishing information letters and press services for target groups
* Organization of fair agencies and conferences
* Provision of transfer services

- Exploitation of interdisciplinary synergy potentials

  * Initiation and formulation of ideas for common projects
  * Promotion and realization of interdisciplinary projects
  * Continued mediation of cooperation partners

- Promotion counsel

  * Information about promotion programmes
  * Investigation in data banks
  * Help with Preliminary examinations and proceedings
  * Support with syndication for EC projects
  * Preliminary negotiations with agencies of the EC-commission

- Administrative duties

  * Finance
  * Personnel administration
  * Project administration (financial controlling, reports)
  * Shaping of agreement
  * Administration of seminar (management of agreement and topics overlapping the institutes)
  * Administration of library
  * Central services (office communication infrastructure, property management).

It is important that scientists can concentrate more on the contents of their work.

4.2. Structure of organization and justice

The R&D Corporation is run as a non-profit private limited company (Ltd.) with the three initiatives as partners and a board of directors. The Ministry of Science and Research of Northrine-Westphalia, the University of Dortmund as well as the promotion association of the R&D Corporation are represented in the latter.
The corporation is open to further initiatives from the university.

4.3. Financing

The initial investments in the R & D Corporation, which amount to 39,8 Mio. DM, are being financed by the federal state of Nordrhein-Westfalen. For this purpose a building is being constructed with 8000qm usable space in office rooms and halls including the necessary equipment in the form of computers, robots and machines.
The construction work started in Summer 1992 and is scheduled for completion in August 1993.

The current operating costs are to be financed through a combination of

  * project promotion through public or private support and a
  * state grant which matches private funding proportionally.

I personally consider that a financial basis which proportionally matches project funds from outside sources is indispensible. It gives a sound basis for securing the tasks in the managerial field of the Corporation as well as the research and development of the particular initiatives. The experience of the Research Centre of Computer Science (FZI) of Karlsruhe, the Centre (Fertigungstechnik) Stuttgart (ZFS) as well as the Research Institute for Applied Oriented Scien-

tific Processing Ulm (FAW) shows very clearly that continued work is only guaranteed with a basic financing

The main reasons for a fixed basic financing are:

* Pilot research for the preparation of new and particularly novel types of projects, which generally cannot be taken over by a specific project partner.

* Generalization of prototypes which have been developed in single project.

* Continued qualification of young research workers for a doctor's degree at the university; this point will be of significance in order to attract most qualified scientists in a highly competitve situation with private enterprises.

* Bridging temporary finance deficits or the financing of deficits for example with EC-projects. Even a very small shortfall in the financing of scientists will in general result in a brain-drain.

5. Third level of the scientific environment: Technology Center and Technology Park Dortmund

In the Federal Republic of Germany there exist 98 founder-/innovation- / and technology centres with in total 2.000 enterprises and 21.000 employees. The Technology Center Dortmund was founded in 1985 and has now 55 firms with 800 employees. It has grown to effectively a size of 25.000 qm from its first completion phase with 4.800 qm after two expansions. The technology park surrounding the centre consists of approximately 45 ha. At present, around 100 enterprises have premises and employ a further 2.000 collaborators. Thus growth is continuing. It has only slowed down due to a lack of extra floor-space, which is now being provided for.

What are the reasons for this extraordinary growth in Dortmund? The reasons for this success are many, as is to be expected. Still a general factor can be identified by a detailed explanation which comes later. This general determinant has been described many times by the crucial phrase "Dortmunder Konsens". "Dortmunder Konsens" means the willingness of all social groups in the city to achieve structural change. During the early 80's, the crisis in the coal and steel industries made people aware that social plans, demands for subsidies and demonstrations with black flags would not bring about change. Politicians, community administrators, financial institutions, chambers and associations, trade unions and the university took the initiative to carry out structural changes. Only in this context can the following factors of performance determining the success of the technology center and the technology park be understood.

5.1. Professional Management

Two extra-official executives, the town councilor responsible for economic promotion and one executive from the Chamber of Commerce and Industry as well as a full-time executive manage the centre. A market economy orientation is the main guide-line. This orientation is guaranteed by financing institutions als banks which are joint partners.
Preconditions for the signing of a lease in the centre are:

* Classification of the development project into one of the technology fields of the centre, that are identical with important research fields at the University of Dortmund,

* Cooperation with a chair/institute of the university,

* Presentation of an agreed corporate plan,

* technical and managerial control of validity checks.

The rents as well are free-market oriented (16,50 DM/qm base rent for office space and 14,00 DM/qm for hall space), since the centre finances itself from rental income and services offered without an operating grant from outside.

5.2. A close relationship to the research potential of the university

The Centre's fields of technology are closely related to the research and teaching fields of the University of Dortmund. Today the main focus is concentrated on the following areas:

* Material flow system / logistics/ technology of packaging
* Materials technology
* Quality assurance
* Cutting manufacturing
* Handling systems / robotics
* Computer science
* Electrical engineering
* Environmental technology
* Microstructural technology

Several enterprises were established with the participation of University personnel. Furthermore a permanent transfer of personnel exists from the University to the enterprises in the Centre and the Park. Many students are employed there during their studies. It is not just a matter of newly-established enterprises either in the Centre or in the Park. It is more a question of some established medium and large enterprises moving either entirely or in part, i.e. just their R&D departments to this place.

Another decisive factor is the proximity of University and Technology Centre to each other, just a 5 minute walk between the two. Despite this fact the transfer office has an office in the Centre.

In order to maintain contact between the University and Technology Centre from an organizational point of view, the Rector - as well as the Rector of the Fachhochschule - is a permanent guest of the board of directors meetings.

5.3. Network

The most important factor of success in my opinion is, that in the meantime a network of know-how and decision makers has been created in and around the Centre, the strength of which has been very effectivly used in individual instances. Thus it is not merely a question of technical know-how but also of managerial expertise in many different guises for instance in strategy development (business consultant), tax questions (tax consultant, certified public accountant) and finance questions (banks, venture capital, consultant for subsidies). This work is being supported by pressure groups from political parties, trade unions or associations. This network is spreading continuously, in planned or unplanned ways. Thus a Centre for Entrepreneurial Education is

being established at the present. This will diminish deficits in managerial education in the area of enterprise establishment.

A counterpart of this Centre can be seen in the establishment of a special business administration study program "Entrepreneurship" at the faculty of Economy and Social Sciences for the first time in the German speaking area.

Furthermore a venture capital fund of 10 Mio. DM exists with special emphasis on enterprises in Dortmund. An international venture-management enterprise was asked to administer the fund.

The representation of such groups as the investors of Dortmund, the executives of the Technology Centre Ltd, the head executive of the Chamber of Commerce as well as the Rector of the University on the advisory Council of this fund is another example of the "Dortmunder Konsens" at work.

6. Summary

Successful innovation on both macro and micro levels depends on synergization of basic research, prototype research and product oriented research and development. These types of research have to be organized and financed separately at the different levels. The interplay between the organizational structures of these levels is decisive.

What I presented, was a mixtum of vision and reality. I think, it is a challenge for researchers and for science managers as well as for politicians to bring this vision of cooperation between the different levels of research and development into reality.