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**Successful Research and Development in a Knowledge-based Economy
Conclusions of the Discussion Leader**

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To summarize the contributions made by so many distinguished speakers over two days seems to be a herculean task. To repeat all aspects, items and ideas would take another two days, which would not be useful.

Therefore, I will do without it and give you some personal impressions of how to organize a well-operating and successful research and development system. This seems to be a good summary of at least the German part of the symposium.

As you heard these days, there is a wide range of different research institutions, financing agencies as well as institutional aims or missions in Germany. In spite of this diversity, there are some main characteristics and common elements. To look for these is the task of every theory-oriented academician. As with every theoretical model, these characteristics presented below are generalizing.

Yesterday, we had a philosophical discussion about the categorization of research into pure basic research, application-oriented basic research and product-oriented research developed by Professor Mittelstraß. For my own purpose, I will differentiate between different forms of research in a similar but slightly different way than Mittelstraß.

Level	Aims	Institutions	Funding
3	market - oriented and competitive R&D	- R&D-departments of industry - Business start-ups	private - seed capital - venture capital
2	market-oriented, but pre- competitive R&D	- Fraunhofer Institutes - institutes at universities - national laboratories	<u>mixed public and private</u>
1	basic and applied R&D independent of <u>interestgroups</u>	- national laboratories - Max-Planck-Institutes - universities	public - DFG - federal government - state government - private foundations

At the first level, there should be basic and applied research and development independent of interest groups such as political parties, business world or unions. This type of research guarantees non-linear innovations, because innovation cannot be planned. In the German system we agree that this kind of research is a public good. Therefore it has to be financed publicly by the Deutsche Forschungsgemeinschaft (DFG), Federal or State Governments or private foundations working for public benefit. Traditionally, this kind of research is organized in universities, institutes of the Max-Planck-Gesellschaft and in national laboratories.

At the second level, market-oriented, but non-competitive research and development has to be done. The results of this type of research can be prototypes, which may lead to products. In Germany, this kind of research is institutionalized in Fraunhofer Gesellschaft and institutes at universities. Some national laboratories are working at that level by now. Because different companies have an interest in the results, funds should be provided by a mixed public-private financing.

On the third level product innovation or production innovation will emerge. Market- and competitive-oriented research and development results in products to satisfy market demands. Because this kind of research leads to individual profit, it should be financed by the private sector. Institutions engaged in product innovation are research-and-development-departments of industrial firms or newly established businesses.

Obviously, there are two main parameters in my model: freedom of science on the one hand and different forms of financing on the other.

Most important for the success of the national research system and national welfare are the links between the different levels. On the one hand: how can an invention, a new theory or simply a good idea generated at the first level of research and development be developed into a product at the third level? Or on the other hand: how can we bring problems of the market or society to the researcher's attention at the first level? In other words, how can we avoid doing research to solve the wrong problems?

This is a communication problem which can only be solved by organizing the process. Some approaches are:

1. Transfer agencies
2. Science and technology parks with institutions of all three levels in one local area
3. Permitting and encouraging research and development at university, Fraunhofer Institutes and own business-start-ups simultaneously or in different life cycles for academics
4. Establishing specific departments or corporations at universities or national laboratories to get closer to the market
5. Organizing boards of trustees with members from different interest groups
6. Implementing computer networks for better communication between the different levels.

The relationships between the various levels of research are much more than an academic exercise. The ways and instruments we use to organize the interrelationship between the three levels of research and development will be responsible for the welfare of our nations to a large extent.