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### Choosing the corporate future. Technology networks of choice concerning the creation of high performance fiber technology

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## SUMMARY

This study deals with the question of what determines the outcomes of the choices made by large corporations when they develop new technology. To this end, four types of choice made in the course of the development of technology are distinguished in Chapter one:

- concerning the entrance to a scientific/technological research domain.
- concerning the product to be developed and its characteristics.
- concerning the processes and additional technologies to be developed in order to be able to manufacture and sell the product efficiently.
- concerning the construction of large scale production facilities.

The outcomes of these choices can only partially be accounted for by existing economic and social theories: In economic theory, only the need for the development of new products or processes is explained, and not the content of these technologies. Theories that also aim at accounting for the content of technology often conceptualize corporations as independent monoliths. The internal relations within the corporations as well as the close relations between corporations are therefore missing in their observations. In this study, relations in regard to the development of a new technology are defined as being the result of an agreement on the part of functional groups on their mutual roles in regard to the development of a new technology. These relations create a technology network. Technology networks can be described by means of a number of characteristics: extension, variety, functional origin of prominent actors, strength of relations, degree of integration, flexibility of relations, degree of secrecy, availability of resources, weak relations with external partners, and the environment of the technology network. In this study, the relation between these characteristics and the outcomes of the choices made concerning technology is investigated further. To limit the influence of 'technology' as a variable, all case studies analyze the development of related technologies, i.e. specific high performance fibers: aramid fibers (Du Pont, Monsanto, Bayer, NPO Khimvolokno, VNIISV, AKZO and ICI) and high performance polyethylene fibers (DSM).

In Chapter 2, the emergence of the fiber industry is described. In the twenties and thirties, the artificial silk industry changed considerably. Large scale internationally operating corporations started to dominate the business. Corporate laboratories were increasingly important. New theories developed in polymer chemistry were of great importance. In Chapter 3, an overview is given of the development of the fiber industry and (high performance) fiber technology after 1945.

In Chapter 4, the choice concerning the entry to a specific scientific/technologic research domain is analyzed. Pioneers, i.e. corporations that enter a domain first, are distinguished from followers, i.e. corporations that, when they enter, are following competitors. Scientists were the most prominent actors at both pioneer and follower corporations. At pioneer corporations, they maintained many weak relations with academic colleagues. At follower corporations, weak relations with innovative customers were more important in order to obtain information on competitors' research findings. Therefore, in these cases the corporate sales department and patent office were more prominent in the technology network than in the case of the pioneers. A positive environment in which to engage in new research was crucial in this stage.

In Chapter 5, the choice of a product is analyzed. Three types of product choice are distinguished: products that had already been foreseen when one entered the domain, unforeseen products which were encountered during research, and products which had been developed by others. Singular and prominent actors were of great influence when a specific product was chosen. The technology network grew gradually when the product had been foreseen. When the product was unforeseen, it could survive by being linked to an existing technology network. In this way, the technology network could rapidly attain a reasonable extension and variety, which was needed to overcome resistance in the organization. In choosing a product following the example of an external organization, the 'image' of the technologic capabilities and motives of this organization were of great importance. Within the technology networks of these corporations, sales departments and patent offices were relatively more prominent. Relations with customers were very important.

In Chapter 6, the choices concerning processes were analyzed. In this stage, many projects were terminated, especially when there were recessions that influenced the environment of the technology net-

work negatively. Termination of a project coincided in particular with a lack of extension and varieties in the technology networks. Availability of resources sometimes influenced the processes that were chosen considerably.

In Chapter 7, a comparison is given of the choices made by two corporations that decided to start manufacturing a high performance aramid fiber on a large scale. Avoiding the risks that were related to this huge investment was of primary concern. Availability of resources was very important in connection with the risks that a corporation could run. Risks could be limited by extending the technology network further.

In Chapter 8, the characteristics of technology networks are evaluated separately and their relative influence on the outcomes of the four choices is estimated. For the survival of an R&D project during its stages of development a number of technology network characteristics were of special importance: strength of individual relations, extension, variety and degree of integration of the technology network. Together, these characteristics appeared to be indicative of the survival of R&D projects if the project was dealing with an unfavorable environment. The content of technologies was determined in particular by the functional background of prominent actors, the actions of singular actors, and the availability of resources. The mechanisms by which these relations between technology network characteristics and the outcomes of the choices made could be understood, are discussed.