

# **Competitiveness in Manufacturing as Influenced by Technology - Some Insights from the Research Project: World Class Manufacturing**

*Frank H. Maier*

*Industrieseminar der Universität Mannheim*

*D-68131 Mannheim,*

*Federal Republic of Germany*

*Phone: (+49 621) 292-3157 Fax: (+49 621) 292-5259*

*e-mail: fmaier@is.bwl.uni-mannheim.de*

## **IMPORTANCE OF TECHNOLOGY FOR MANUFACTURING'S COMPETITIVENESS**

Continuous technological change is often cited as a prerequisite for competitiveness and survivability of companies and whole economies. Porter, e.g., characterizes technological change "... as a great equalizer, eroding the competitive advantage of even well-entrenched firms and propelling others to the forefront..." (Porter 1985) and therefore influences the structure of whole industries. Although technology influences all activities in a company's value chain, in particular technology may affect a company's competitiveness in the field of manufacturing. Products manufactured and sold to the customer, processes used to make the products, and information systems to integrate the various areas of a company, are each part of the technology in use and are expected to show an impact on the performance of the manufacturing system. Hence, effective implementation and use of technology is to be seen as a strategic weapon in the battles of a company against competition.

However, the question is whether outstanding technological performance really is a critical factor for the success of manufacturing. Moreover, can technology be seen as independent to other areas of the company? What are the linkages and feedback relations to these? Does World Class Manufacturing require remarkable use and effective implementation of technology? What distinguishes World Class Manufacturers from traditional plants with respect to their use and implementation of technology in the system?

## **AIMS OF THE PROJECT**

The paper is within the scope of the international research project "World Class Manufacturing". The aim of the project is to analyze the critical success factors in manufacturing plants like, e.g. quality, human resources, information technology, product and process technology, Just-in-Time, and manufacturing strategy. A particular area of interest in this project is the field of technology-which is the main focus of this paper. The project tries to answer the questions above on the basis of a statistical and feedback oriented analysis of an international empirical research data base. The data base comprises qualitative and quantitative information collected in more than 140 manufacturing plants from USA, Japan, Great Britain, Italy and Germany. In the context of the project in each plant 26 employees-from the plant manager to the direct labor employees-had to fill out questionnaires asking for a plenty of subjective and objective data (for a brief description see e.g. Sakakibara/Flynn/Schroeder 1993). The paper investigates the impact of technology and related factors on competitiveness and discusses potential feedback structures driving the processes of technology development, implementation, and use as well as their impact on performance.

## **TECHNOLOGY, COMPETITIVENESS AND PERFORMANCE**

Technology is a sparkling term which has to be clarified first. Traditionally technology comprises the aspect of a plant's products-product technology-and production-process technology or manufacturing technology. However, nowadays technology also has to deal with the aspects of information systems and information technology. The different aspects of technology are closely interrelated. E.g., Computer Integrated Manufacturing (CIM) as a part of the manufacturing system is unthinkable without information technology. Product design and product technology strongly influence the producibility in manufacturing and define the manufacturing technology required. Computer Aided Design (CAD) is also a means from the field of information technology, speeding up the process of development of new products (Steele 1989). As a result it seems that technology becomes a competitive weapon only if all technology dimensions are linked together in the manufacturing system of a plant.

All three dimensions are assumed to be core factors with direct and indirect impact for the competitiveness and the performance of a plant. Moreover, the effective use of technology itself is influenced by several other factors (see Fig.1 for an overview on the interrelations and the results of the statistical analysis of causality). Effective use of **manufacturing technology** is a means of achieving flexibility to changes in production volume, to changes in the job shop schedule, and to changes in the type of product to be manufactured. High quality products, which are not only a result of the application of comprehensive systems of quality management, but also influenced by the technology used in manufacturing; which e.g., emphasis smoothly running machines with low deviation of tolerances, scrap, and rework, as well as the use of machines with automated inspections. Low costs are influenced by the manufacturing technology as well e.g., through economies of scale as well as economies of scope, low down time of equipment caused by production stoppages, low set up time, and a low percentage of rework and scrap. Manufacturing technology also has the role to ensure a plant's ability to meet customers demands regarding delivery on-time and short delivery times.

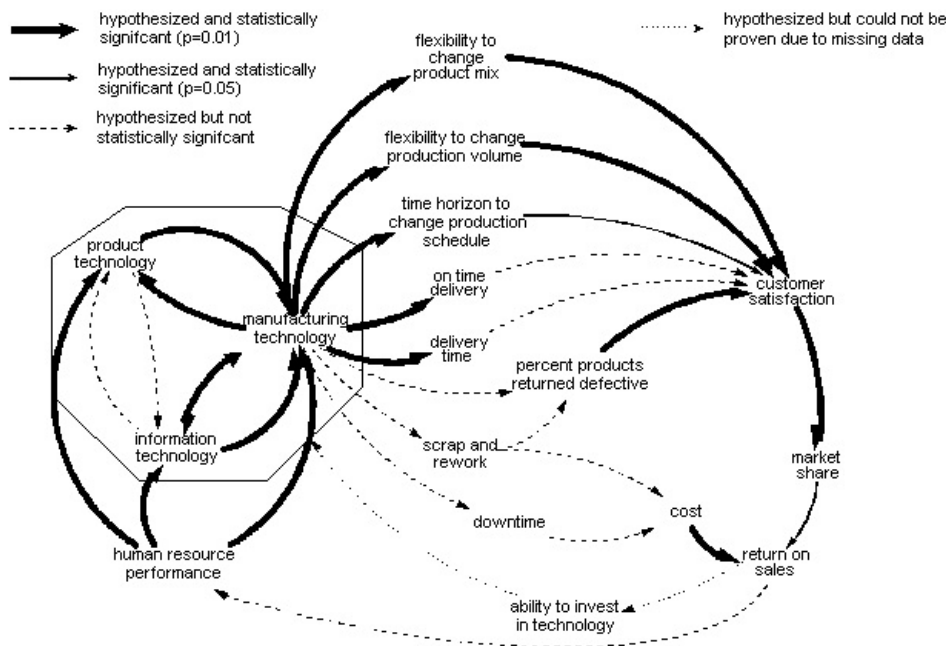


Fig. 1: Technology, competitiveness and performance: some causal linkages

High standard **product technology** is seen as the prerequisite for sustaining competition. The better the products of a company are, the higher the competitive advantage is. High performing plants use practices to increase their ability to introduce new products more frequently and faster than the competitors. They serve as a means to increase customer's benefits and finally to improve or sustain the competitive advantage. However, product technology should not be seen as isolated from production. Quality, part numbers and manufacturability defined by product development have a strong influence on manufacturing, the necessary process technology, and the ability of marketing to promote sales. Hence, World Class Manufacturers regard these aspects as interrelated. They consider customer needs as well as supplier's and manufacturing's capabilities in early stages of product development.

With the increasing capabilities of computers and information systems the impact of **information technology** is at least growing and it is eventually getting the dominating influence in the manufacturing field (Steele 1989). Information technology is the basis for a plenty of concepts directly related to manufacturing at the plant level. Computer integrated manufacturing (CIM) with its components of CA-components like CAE, CAD, CAM, CAP, or CAQ are concepts that would never exist without computers and information technology. Furthermore, information technology influences all activities in a plant, not only manufacturing. Communication processes can be accelerated, planning systems can be improved, through e.g., improved availability of and access to data.

However, even with this comprehensive view it is still insufficient solely to be the technological leader in an industry. In World Class Manufacturing technology has now ended in itself. Products, manufacturing processes and supporting information technology "fit" to the plant. The people in the plant are using manufacturing and information technology and design product technology: the employees make technology in all parts and at all activities in the plant work. This requires skilled employees and a well designed human resource management system.

## OUTLOOK

The paper discussed some of the dimensions related to technology, their influences and their effects on competitiveness and performance. Although the analysis is a first step in a more detailed investigation in this field, the analysis shows its importance and complexity. Since the data collection is not finished yet the results comprised in Figure 1 only have preliminary character. Further research will use the empirical data base intensively to prove assumed causal relations for their empirical evidence.

## LITERATURE

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