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Strategic Evaluation of Technological Capabilities, Competencies and Core-Competencies of Manufacturing Companies

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Abstract

In high-wage countries, establishing and maintaining technological know-how is a key success factor for manufacturing companies. To fulfill future manufacturing requirements, a dynamic range of potentially available technologies exists. Each of them is characterized by an evolutionary development, whereby the maturity of a manufacturing technology varies. In order to hold technological leadership and to increase competitive advantages, companies must be aware of the capability and competency maturity stage of manufacturing technologies. This article presents a model, which aims to determine the maturity of a company's technological capabilities, competencies and core-competencies.

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Keywords: Manufacturing Technologies; Strategic Technology Planning; Technology Maturity; Capability and Competency Assessment

1. Introduction

Manufacturers in high-wage countries are exposed to an intensive international competition [1]. In order to stay competitive, companies are forced to deploy manufacturing technologies which are best suited to fulfill future requirements [2]. In this context, the term 'manufacturing technology' denotes all manufacturing processes which are needed to produce a product [3] and are referred to 'technology' in the following.

Technologies pass through an evolutionary development, whereas a technology's maturity increases over time [4]. This evolution can be described as a technology life cycle. However, technologies are not always mature enough to be used effectively and efficiently for manufacturing tasks. Especially emerging technologies might need a further development until they can be integrated in the existing production environment [5,6]. For this reason, companies have to evolve resources, capabilities, competencies and core-competencies for the respective technology. These elements build upon one another [7,8], as shown in Fig. 1. Furthermore, capabilities, competencies and core-competencies constitute technological know-how.

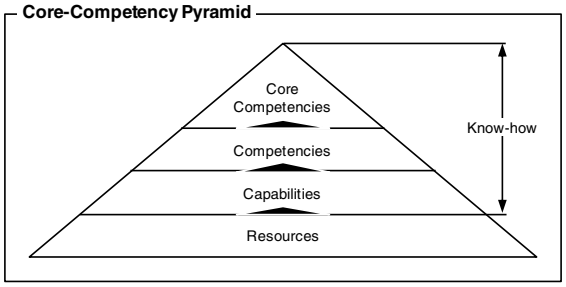

Fig. 1. Set-up of Core-Competencies (based on [7])

Resources include physical resources (e.g., raw materials), human resources (e.g., experience) and organizational resources (e.g., processes) [9]. Knowledge and skills for solving technical problems are defined as capabilities, whereas the combination of single capabilities is defined as competencies [7]. Core-competencies arise from the synthesis

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of selected competencies [10] which are necessary to establish competitive advantages [11]. Core-competencies are both long-lasting and transferable into different markets, divisions or products, but cannot be imitated or substituted [12]. Establishing and extending core-competencies is a key success factor for manufacturing companies. For this purpose, companies must be aware of the current maturity stage of their core-competencies.

Therefore, this paper focuses on a model which aims to determine the maturity of a company's technological resources, capabilities, competencies and thus core-competencies.

2. Technology Evaluation

In order to evaluate the maturity of a technology based on a company´s capabilities and competencies, the temporal evolvement has to be taken into consideration. This development is described as a technology life cycle [13].

2.1. Technology Life Cycle and Maturity

In the literature a wide range of technology life cycle models exists [e.g., 13,14,15,16,17,18]. Fig. 2 displays one of these models wherein the growth of technology maturity is plotted against time [13]. In this context, maturity refers to the stage of development of a technology [19].

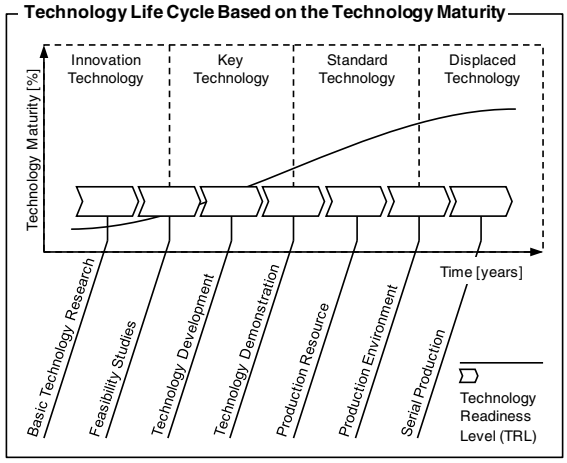

Fig. 2. Technology Life Cycle Based on the Technology Maturity (based on [13,19]).

The technology life cycle can be divided into four different stages including innovation technology, key technology, standard technology and displaced technology [13].

In order to determine the current stage of a technology's maturity, qualitative and quantitative models exist. *Qualitative* models investigate the maturity roughly by categorizing the technology according to qualitative indicators (e.g., time needed for further development), such as those presented by [16]. In contrast, *quantitative* models recurrently assess the maturity based on questionnaire responses regarding principles, activities, concepts or prototypes of a technology. A fundamental model was introduced by the National Aeronautics and Space Administration (NASA) to assess the current maturity stage for aerospace and astronautic systems using nine technology readiness levels (TRLs) [20]. *Brousseau* et al. transferred the approach to manufacturing processes and modified the aforementioned TRLs reducing them to seven (cf. Fig. 2): basic technology research; feasibility studies; technology development; technology demonstration; production resource; production environment; serial production [5,6]. *Reinhart & Schindler* combined the two models of *Mankins* and *Brousseau* et al. with the technology life cycle according to *Ford & Ryan*. Thereby, resources are evaluated to assess the maturity of a manufacturing technology [19].

2.2. Technological Capability and Competency Evaluation

In the context of technological capabilities and competencies some of the most significant approaches [8,21,22,23,24] are briefly explained in the following.

Zehnder developed a model for the competency based planning of technologies. Herein technological resources, capabilities, competencies and core-competencies in companies are analyzed and evaluated. This model takes four aspects into consideration: direction and specifications of the technology-oriented competitive strategy; current product structures and product systems; technological core-processes of the company; structures of the technologies and capabilities. Methods such as interviews, workshops and analysis of processes and costs are applied within the model [21].

Fengler describes a three-step approach to indentify the core-competencies of a company. In the first step, mind-maps of strategic important resources are created by conducting interviews with employees who have abstract knowledge of the company's operations. The mind-maps are the basis for a standardized questionnaire which allows an evaluation of the resources of the company. In the last step, an analysis of the environment and the results of the questionnaire are used to recommend how to develop the company's core-competencies [22].

Campbell developed a framework to enhance companies to align information technology with business objectives through the systematic identification of core-competencies. In this framework, the relationship between resources, capabilities and core-competencies is reflected. Resources are the basis of a company and are divided in quality of relationship, human capital and infrastructure flexibility. These resources are combined to form capabilities. Each department or business unit within a company might possess its own resources and capabilities. The combination of the resources and capabilities of all the functional groups in the company forms the core-competencies which are finally designed to provide value to the costumer [8].

Rush et al. developed a technology capability assessment tool designed to help locating companies within four archetypes based on their maturity on nine key dimensions of the management of technology. Type-1-companies are passive or unaware about the need for technological change. Type-2-companies recognize the need for change but are unclear