

## **ANALYZING THE INTEGRATION OF TECHNOLOGY PLATFORM STRATEGIES INTO THE SITUATIONAL CONTEXT OF DIVERSIFIED COMPANIES**

**GUENTHER SCHUH**

*Laboratory for Machine Tools and Production Engineering  
RWTH Aachen University  
Steinbachstrasse 19, 52074 Aachen, Germany  
g.schuh@wzl.rwth-aachen.de*

**SIMON RYSCHKA**

*Fraunhofer Institute for Production Technology IPT  
Steinbachstrasse 17, 52074 Aachen, Germany  
simon.ryschka@ipt.fraunhofer.de*

**ALEXANDER ROLLMANN**

*Fraunhofer Institute for Production Technology IPT  
Steinbachstrasse 17, 52074 Aachen, Germany  
alexander.rollmann@ipt.fraunhofer.de*

**TIM WETTERNEY**

*Fraunhofer Institute for Production Technology IPT  
Steinbachstrasse 17, 52074 Aachen, Germany  
tim.wetterney@ipt.fraunhofer.de*

The significance of technology platforms as interconnected networks of technological knowledge is steadily growing in diversified companies. The reason is that technology platforms support diversified companies to handle the conflicting priorities of fulfilling the customer demand for individualized innovations, while generating company-wide technological synergies. Hence, the success of diversified companies can be significantly affected by the implementation of technology platforms and the development of consistently integrated technology platform strategies. This implies that is essential for diversified companies to correctly integrate their technology platform strategies into their company's specific situational context. In practice however, the consistent integration of technology platform strategies into a diversified company remains a major challenge. The reason is mainly due to the fact that there is no established opinion about the specific situational context factors of diversified companies that need to be considered, when developing a technology platform strategy. Additionally, there is also no guideline on how these factors are influencing the platform strategy development. Therefore, in this paper we introduce a framework that illustrates the relevant situational context factors of diversified companies and describes their influence on technology platform strategies.

**Keywords:** technology platform, technology platform strategies, diversified companies, technology management, strategy, diversification

## Introduction

Diversified companies, especially in high-wage countries such as Germany or the US, are facing the constant challenge to launch newly developed products at shorter intervals into the global marketplace (Schuh and Ryschka 2015). Shorter product and technology life cycles and therefore greater financial uncertainties for technological innovations are the consequence (Ford and Saren 2001). The customers' increasing demand for individualized products tend to aggravate these already complex circumstances for diversified companies (Schuh et al. 2011). The identification of technological synergies and the consequent reduction of organizational complexity thus become a compulsory corporate action (Rudolf 2013). Simultaneously, it is necessary to exploit unique technologies across multiple businesses, in order to offer a maximum amount of individualized technological solutions for the customer in a cost effective way (Jolly and Nasiriyar 2007, Böhlke et al. 2005). This is why an increasing number of diversified companies manage their technologies independently from their products within technology platforms (Shapiro 2006, Högman 2011). Thus, strategic decisions about the long-term orientation of technology platforms have a critical impact on the success of diversified companies. Due to their cross-functional character, technology platform strategies require a high need for coordination and a particular effort for the correct integration into a company's specific situational context (Berglund et al. 2008).

In practice however, many diversified companies struggle with the integration of technology platform strategies into their situational context. This might lead to a loss of the full business potential of technology platforms for these companies. The integration problems often originate from the lack of consensus about the situational context factors of diversified companies that need to be considered when developing a technology platform strategy and the lack of consensus about guidelines on how these factors are influencing a platform's strategy.

From the theoretical perspective, there is a lack of research with regard to the integration of technology platform strategies into the situational context of diversified companies. This is surprising, due to the huge integration problems in the daily practice of diversified companies and the negative economic impact of uncoordinated technology platform strategies.

Therefore, in this paper we introduce 10 hypotheses, which illustrate the influence of a diversified company's situational context on technology platform strategies. By doing so, we intend to generate guidance for diversified companies, whilst developing and implementing a coordinated technology platform strategy. Additionally, we intend to develop a framework for future research in the field of technology platform strategies.

Section 2 of the paper specifies the terms 'strategy', 'technology platforms' and 'technology platform strategies' for the purpose of the paper. Section 3 describes the situational context of diversified companies. Section 4 comprises the literature review of previous research, concerning the integration of technology platform strategies. Based on the need for further research, 10 hypotheses are formulated about the influence of a diversified company's situational context on technology platform strategies in section 5. The conclusion in section 6 completes the paper.

## Technology platform strategies

The following section is specifying technology platform strategies for the purpose of the paper. The understanding and systematic description of the strategic elements of technology platforms are the foundation for the development of the hypotheses in section 5.

### *Strategy*

The term ‘strategy’ has no universally accepted definition in literature until today (Macharzina and Wolf 2010). Strategies, in the classical comprehension, are designed intendedly and represent a rational plan regarding future measures (Bamberger and Wrona 2004, Macharzina and Wolf 2010). MINTZBERG argues that strategies do not necessarily have to be the result of formal planning and states that they can be developed in an unintended way as well (Mintzberg et al. 1998). For this purpose, he distinguishes between intended, prospective strategies and already realized, retrospective strategies, as visualized in figure 1 (Mintzberg 1978).

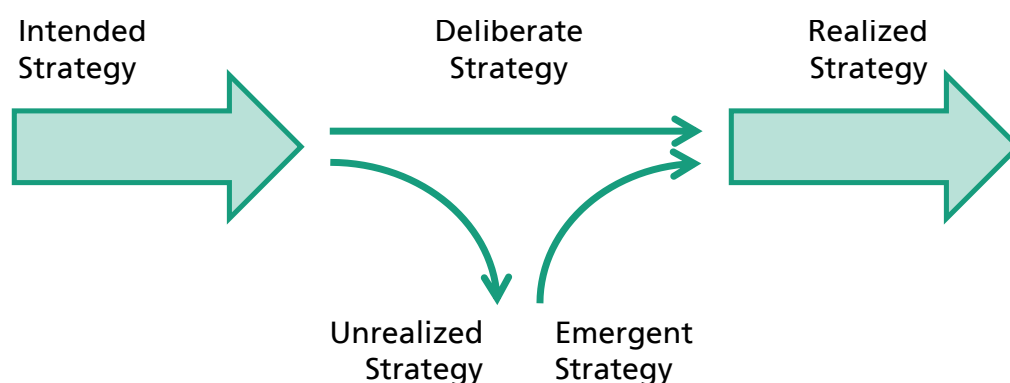


Figure 1: Different types of strategies according to MINTZBERG (Mintzberg 1978)

The second relevant definition concerns the required width of the strategy content (Bamberger and Wrona 2004). According to CHANDLER as well as RÜEGG-STÜRM, a strategy comprises the definition of strategic goals as well as courses of action to reach these goals and the allocation of resources to realize the actions (Chandler 1995, Rüegg-Stürm 2005). On the other side, the narrow understanding of strategies focuses only on the selection of actions, in order to achieve the goals (Bamberger and Wrona 2004).

In this paper, the term strategy is defined in the classical comprehension and comprises the wide understanding of the strategy content, focusing on strategic goals, courses of action and the allocation of resources. This corresponds to MINTZBERG'S understanding of an initially intended and subsequently realized strategy (Mintzberg 1978). In this way we are able to ensure a holistic perspective on the influence of the situational context factors of diversified companies on technology platform strategies in section 5.

### Technology platform

The term ‘technology platform’ has been used inconsistently in the past (Jolly and Nasiriyar 2007). Thus, it is necessary to define the term clearly for the purpose of this paper. It is defined that technology platforms represent a unique and interconnected network of a diversified company’s internal technological knowledge base (Breuer 2006, Rosier 2006). This internal network of technological knowledge stretches over multiple business units, in order to enable the exchange of relevant technological information and to enable the exploitation of a maximum amount of product applications (Stig 2013, Böhlke et al. 2005).

Figure 2 illustrates an exemplary technology platform in our understanding. The technology platform connects the technological knowledge on sealing technologies within a diversified company. The interconnected network of technological knowledge consists of five individual technological knowledge areas (T1-T5). These knowledge areas include personnel and informational knowledge on materials, production processes and follow-on operations as well as non-destructive test methods. By connecting these initially separated knowledge areas, which span in total over the three business units “renewable energy”, “aviation engines” and “construction and housing”, the diversified company is able to collectively facilitate new products for their various business units. For example, the diversified company is able to improve their seal lip profiles and decrease the fuel consumption of their aviation engines with the effort of the technology platform experts.

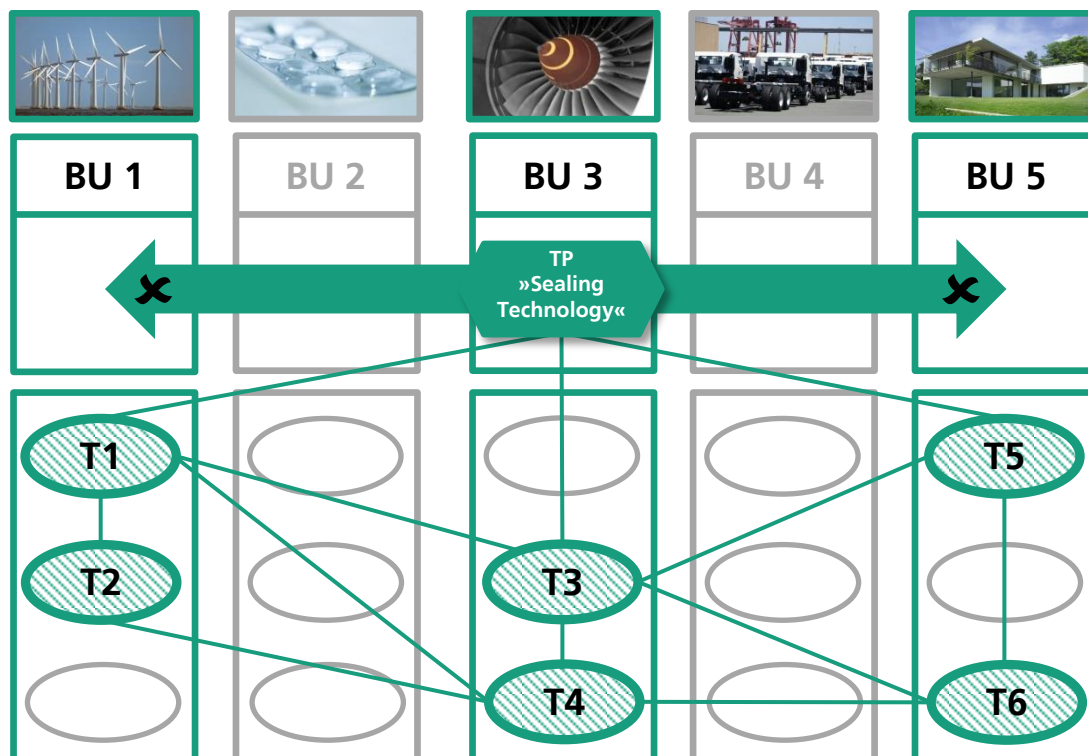


Figure 2: Schematic excerpt of the exemplary technology platform “sealing technology” within a diversified company

### *Strategy elements of technology platforms*

As described, strategies have to provide information about the following areas: *strategic goals, course of action, allocation of resources* (Chandler 1995, Rüegg-Stürm 2005). However, this classification of strategic areas can only deliver an initial overview and does not specify the relevant strategy elements of technology platforms that are necessary for the derivation of hypotheses about the integration into the situational context of diversified companies. This is why the three strategy areas are detailed for the purpose of the paper in the following subsection.

The fundamental *strategic goal* of a technology platform is to leverage unique technological knowledge as synergistically as possible (technology perspective) into a maximum amount of different business units of a diversified company (market perspective) (Breuer 2006, Rosier 2006). The technology perspective can be further broken down into the technology performance dimension as well as the technology timing dimension, as more specific decisions of a technology platform strategy (Böhlke et al. 2005, Schuh and Ryschka 2015). On the other hand, focusing the market perspective of technology platforms, it needs to be determined, whether a technology platform targets existing or unexplored markets with existing or new product applications (Jolly and Nasiriyar 2007, Schuh and Ryschka 2015).

The *course of action* defines the relevant measures, in order to realize the strategic technology platform goals. The focus of value creation within a technology platform is constituted by the technology management process and its main activities technology intelligence, technology planning, technology development and technology exploitation (Schuh and Ryschka 2015). Technology intelligence is the technology management activity that aims to identify technological opportunities and threats for diversified companies, by systematically capturing technological information needed for the technology planning (Ashton and Klavans 1997). Based on the activities of the technology intelligence, the technology planning activities are conducted to decide about the development and use of relevant technologies, in order to generate competitive advantages (Floyd and Wolf 2010). Subsequently, the technology development is focusing on the creation of new technological knowledge, either within or outside the own company (Roberts 2001). Finally, technology exploitation is dealing with the leverage of technologies in familiar or unexplored markets, in order to maximize the profits of a diversified company (Schuh and Drescher 2014).

The range of services that can be offered by a technology platform is considered as another element within the strategy area 'course of action' (Rüegg-Stürm 2005). Based on the chosen technology management activity, it can be differentiated between more theoretical services, mostly with intangible outcomes or more practical services with rather tangible outcomes (Böhlke et al. 2005, Levandowski et al. 2013, Schuh and Ryschka 2015). A possible theoretical service for example can be the generation of a clear overview of technology platform experts, know-how and running projects (Böhlke et al. 2005). Another, rather theoretical service, could be the assessment of new technologies or the development of technology roadmaps (Rosier 2006). On the other side, a possible technology platform service can also be the development of physical and practical technology demonstrators that can be customized for further development projects in the involved business units of a diversified company (Böhlke et al. 2005, Breuer 2006, Schuh et al. 2014).

Finally, technology platform stakeholders need to be addressed that shall benefit from the platform activities. The technology platform stakeholders are the functional organizational units that make a high contribution to the added value of a diversified company, namely the procurement, the research and development, the production and the marketing (Schreyögg 2008, Schuh et al. 2014). The procurement can receive a clear orientation regarding the acquisition of technologies and can avoid uneconomical, technological acquisitions (Böhlke et al. 2005). Also, technology platforms can be implemented as a prominent aspect of the communication with customers and act as an own brand, with regard to the marketing activities of a company (Böhlke et al. 2005). Finally, the research and development and the production can be defined as the core stakeholders of a technology platform, due to their direct involvement in technology management activities (Rosier 2006, Breuer 2006).

The *allocation of resources*, as the third strategy area of a technology platform, is necessary to realize the defined course of actions. First of all, the technology platform organization needs to be considered (Stig 2013). On the one hand, a technology platform can be implemented as a real organization with physical workplaces or virtually with dedicated content-management systems to facilitate the communication across the participating business units (Böhlke et al. 2005). On the other hand, it needs to be decided, whether to implement a technology platform permanently with employees that are contracted without a time restriction or temporary with a designated date for the disestablishment of the platform structure and the staff (Schuh and Ryschka 2015, Breuer 2006, Böhlke et al. 2005).

Second of all, different roles and responsibilities need to be established (Böhlke et al. 2005). Technology experts realize the defined technology platform activities on an operational level, whereas technology platform managers coordinate their work (Breuer 2006, Rosier 2006). The decision makers are part of the management of the participating business units and are responsible for the supervision and approval of the technology platform activities. Finally, technology platform promoters on corporate level communicate the platform achievements to employers and customers (Schuh and Ryschka 2015 Böhlke et al. 2005).

Thirdly, the financing aspect of technology platforms has to be seen as another relevant strategic element (Böhlke et al. 2005, Schuh and Ryschka 2015). Financing a technology platform exclusively with central corporate budget enables to remove most of the individual interests of the participating business units, whereas financing with business unit budget tends to result in a stronger orientation of technology platform activities to the specific business unit interests (Breuer 2006, Rosier 2006, Schuh and Ryschka 2015).

Fourth, the knowledge documentation has to be considered as another strategic element of technology platforms. On the one hand, it is possible to establish a direct face-to-face communication within the technology platform, in order to ensure personal knowledge transfer (Stig 2013). On the other hand, a more formalized documentation of technological knowledge can be established with IT-tools like Wikis, in order to offer a possibility for the employees of diversified companies to share their technology related knowledge with colleagues in other parts of the world (Stig 2013, Schuh and Ryschka 2015).

Figure 3 summarizes the presented strategy elements of technology platforms, which are functioning as the foundation for the formulation of 10 hypotheses about the influence of a

diversified company's situational context on the specific technology platform strategy elements in section 5.

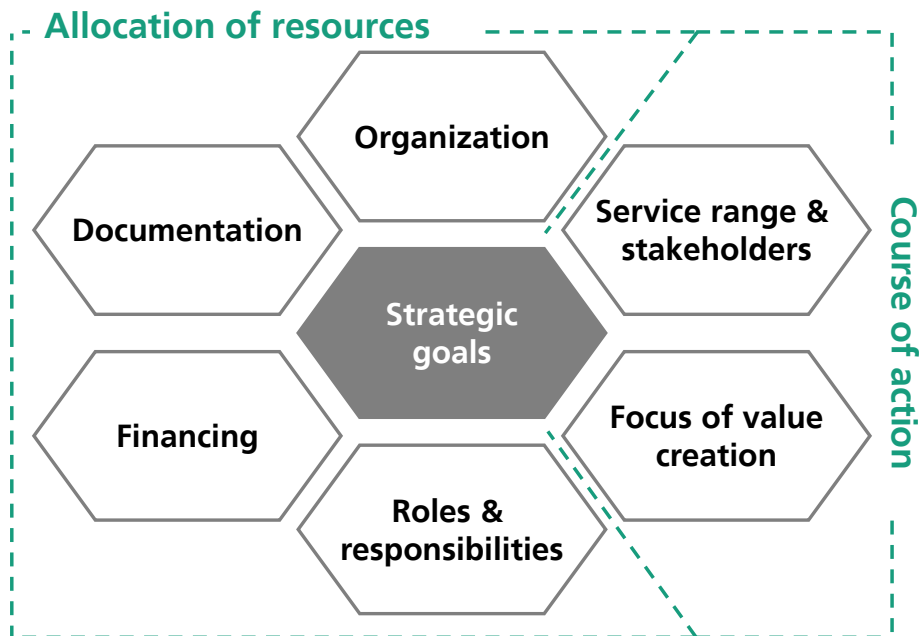


Figure 3: Strategy elements of technology platforms

### **Situational context of diversified companies**

The situational context of diversified companies is analyzed in the following section, in order to identify the relevant situational context factors that need to be considered for the integration of technology platform strategies in a diversified company. Hereby, it is necessary to distinguish between company internal context factors and company external context factors for the further analysis (McGrath 2000, Rosier 2006). The internal context is characterized by the possibility of a company to actively influence and change the characteristics of the context factors (Hofer and Schendel 1978). It can be differentiated between the strategy situation, the structure situation, the culture situation and the resource situation as relevant internal context factors for the integration of a technology platform strategy into a diversified company (Rüegg-Stürm 2005, Hofer and Schendel 1978). On the other side, the external context is characterized by the environment of a company, which is driving industry competition and thus there is a rather low possibility for direct influence (Kieser and Walgenbach 2003).

#### *Internal Context*

The *strategy situation* of a diversified company can be mainly characterized by the following three strategies that are essential for the integration of technology platforms: the corporate strategy, the business unit strategy and the technology strategy (Rosier 2006, Breuer 2006). Corporate strategies are formulated on the top hierarchical level and set the direction for the development of the entire company (Macharzina and Wolf 2010). The development direction of a company can be divided into the strategic decisions 'growth', 'stabilization' or 'disinvestment' (Bea and Haas 2005). These strategic decisions determine, which business

units need to be kept and which business units need to be abandoned. Business unit strategies are designed for each division and describe defensive or offensive measures of a company to maintain its competitive position (Grant 2005). For this purpose it is necessary to become either the most cost effective competitor or offer those value propositions, which have unique features (Porter 1998). Technology strategies reflect those conceptual decisions that refer to the development and use of current and future technologies (Wolfrum 1994). On the one hand, it can be distinguished between the technology performance (leader or follower) as the company's technology status with regard to the current technological state of the art in the industry and the innovation timing (leader or follower) as the point of time, when a company enters with a technology the market for commercialization (Ford 1988). On the other hand, it can be distinguished between the strategic decision of technology sourcing (internal or external) and the strategic decision of technology commercialization (internal or external) (Wolfrum 1994).

The *structure situation* of a diversified company can be described by the following two dimensions: organizational structure and operational structure (Rüegg-Stürm 2005). The organizational structure determines, how a company is structuring their activities from an institutional perspective (Daft 2004). Here, it can be differentiated between a mainly functional structuring of activities (functional structure), a business and market focused structuring (divisional structure) and a structuring, according to geographical areas (geographical structure) (Hungenberg and Wulf 2011, Rüegg-Stürm 2005). In contrast, the operational structure of a company is illustrating, how a company is synchronizing their activities from a process flow perspective (Rüegg-Stürm 2005, Chiesa 2001). It can be distinguished here between the quality of the process flow development, meaning how quickly is a company able to optimize their processes and the quality of process flow reliability, meaning how stable are the established processes (Hungenberg and Wulf 2011).

The *culture situation* of a diversified company is regarded as the third relevant internal context factor. It comprises all values and behaviours that contribute to the psychological mindset of the members of a company (Kotter and Heskett 1992). In general, a strong corporate culture leads to clearly communicated and understandable values and norms, so that they are supported by the majority of employees (Ravasi and Schultz 2006). More specifically, the following two cultural aspects are further detailed for the purpose of the paper: innovation culture and risk culture. For the innovation culture aspect, it can be distinguished between a company mindset, where the employees don't accept external ideas and reject the collaboration with external partners (not-invented-here syndrome) and a mindset, where the employees actively seek the integration of external ideas (open innovation) to facilitate technological innovation (Katz and Allen 1982, Chesbrough 2010). For the risk culture aspect, it can be distinguished between risk-aversion, risk-neutrality and risk-seeking that shape the risk decisions of the management and the individual employees (Das and Teng 2001).

According to MÜLLER-STEWENS, the *ressources* of a company can be mainly divided into material resources and immaterial resources (Müller-Stewens 2003). Traditionally, material resources, like physical production facilities or machines, play one of the dominant roles in diversified companies that put an emphasis on the production of goods (Müller-Stewens 2003). Also, especially financial resources (both equity capital and debt capital) play the



major supporting role for diversified companies, in order to finance the installation and maintenance of the production facilities (Schultz 2011). However, the strong shift to a knowledge-driven society in general and business that are mainly dominated by the creation of unique and intangible knowledge lead to the an increasing importance in a highly qualified base of human rersources (Castelfranchi 2007, Tyson 1997). This is why, human rersources and their intangible knowledge need to be considered as another major factor of the resource situation of a diversified company.

Figure 4 summarizes the presented situational context factors of diversified companies that function as the second relevant foundation, next to the derivation of technology platform strategy elements in section 2, for the formulation of hypotheses in section 5.



Figure 4: Internal context factors of diversified companies

### *External Context*

The external context of diversified companies can be divided into a global environment and a market-specific environment (Drucker 2001). While the global environment (e.g. macro-economical, political, social etc.) is not influencable by a single company at all, the specific markets of a diversified company (micro environment) can be possibly influenced by the decisions of the general management (Macharzina and Wolf 2010). In the further course of the paper we focus our attention on the market-specific environment of a diversified company, because the influence of these situational factors on the technology platform strategies can be directly backtraced and can be potentially influenced by the decisions of the general management. A common approach for the characterization of the market-specific environment is introduced by PORTER and his model of the five forces (Porter 1998). According to PORTER, the driving forces of competition in the market-specific environment can be distinguished between the baragining power of suppliers or buyers, the threat of new entrants or substitute products and the extent of industry competition between rivals (Porter 1998).

*Bargaining power of buyers* is prevalent, when there are fewer potential buyers within a market so that they can strongly influence the market behaviour of a company (Porter 1991). On the other hand the *baragining power of suppliers* is existing, when there are only a few suppliers and a company is therefore not able to easily find alternatives for their supply-chain (Porter 1998). The *threat of new entrants* can be found in case new companies can be started up in a market without substantial investements prior to the market entry (e.g. the internet made it possible in many markets) (Porter 2001). A high *threat of substitute products or services* for a company is prevalent, if there is a huge amount of comparable products without significant differences in their selling propositions with regard to the own product (Porter 1998). Finally, *industry competition* is characterized by the amount of existing market players and the type of rivalry between these players (e.g. price competition etc.) (Porter 1998).

Figure 5 is summarizing the five driving forces for competition in the market-specific environment of a diversified company according to PORTER.

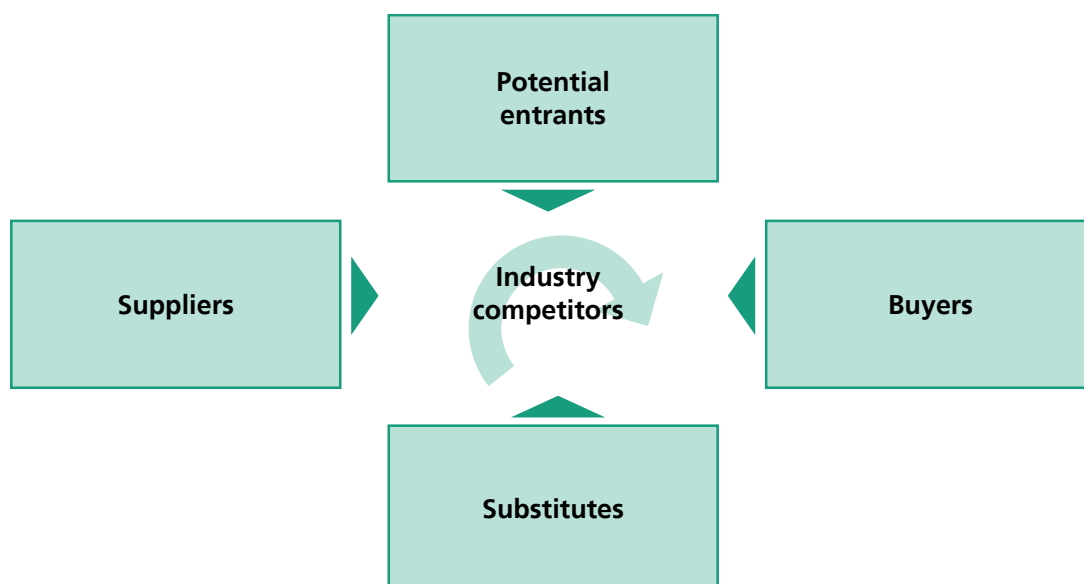


Figure 5: Forces driving the market-specific competition according to PORTER (Porter 1998)

### Literature Review

The following section comprises the review of literature that addresses the influence of the situational context of diversified companies on the technology platform strategies. It is analyzed, how the situational factors of diversified company (internal or external) are influencing the strategy elements of technology platform strategies. Additionally, it is also illustrated, which contributions and deficits are made within the investigated papers.

BÖHLKE ET AL. discuss in their publication the particular influence of a company's organizational structure on the organization as well as the stakeholders of a technology platform (Böhlke et al. 2005). The authors focus especially on the real and permanent implementation of technology platforms and describe several examples from their industrial experience that facilitate such an organizational platform configuration (Böhlke et al. 2005). However, the authors do not describe other relevant influencing factors and also do not consider the analysis of other relevant strategic elements of technology platforms.

STIG focuses on the documentation of technology platform knowledge and discusses different forms of knowledge documentation for different forms of operational company structures (Stig 2013). The author defines three different levels of knowledge documentation, based on different operational structures within a diversified company (Stig 2013). Even though the author introduces an overview of different documentation forms, he fails to put his results in a broader perspective, by not analyzing other influencing factors of diversified companies.

NASIRIYAR deals in her publication with the influence of a diversified company's resource situation on the focus of value creation within a technology platform (Nasiriyar 2010). The author particularly focus on the influence of a company's production technology base on the extent of technology exploitation activities and postulates a higher amount of exploitation activities with a broader base of production technologies (Nasiriyar 2010). Despite the accurate description of technology exploitation opportunities, the author lacks to put the results into a broader perspective of the entire situational context of a diversified company.

LEVANDOWSKI ET AL. discuss the influence of the production technology resources on the financing of technology platforms, using a case study from the aerospace industry (Levandowski et al. 2013). The authors postulate that a technology platform has to finance itself by reducing manufacturing costs through state-of-the-art production technologies (Levandowski et al. 2013). Although the authors focus on the very important financing aspect of technology platforms, they neglect other relevant elements for the integration of technology platform strategies and build their findings only upon one single case study.

Focusing on the external market situation of a diversified company, BERGLUND ET AL. investigate the influence of the industry competition on the focus of value creation within a technology platform (Berglund et al. 2008). The authors describe the competitive situation within the engine supplier market for aerospace applications and describe the implications for the technology exploitation activities (Berglund et al. 2008). However, the authors focus solely on one industry and do not put other strategic elements of technology platforms into consideration.

DE ALMEIDA AND MORALES describe the influence of the threat of product substitutes for oncological drugs on the range of services offered by technology platforms (De Almeida and Morales 2015). Using Brazilian medical companies as an example, the authors focus especially on detailed technology roadmaps as the preferred service of a technology platform in their Brazilian case study (De Almeida and Morales 2015). Even though the authors introduce an overview of technology platform services, influenced by the threat of substitutes, they solely focus on the medical industry in Brazil. This leaves out a possible generalization of their results, because of their special industry focus.

In total, six exemplary research papers have been analyzed, demonstrating individual influence possibilities of situational context factors of diversified companies on strategic elements of technology platforms. However, the illustrated research approaches lack a comprehensive and systematically derived description of the impact of situational context factors on technology platform strategies. The purpose of this paper is to address this need for research and to display the influence of the situational context of diversified companies on technology platform strategies in the form of hypotheses.

## Coordination of technology platform strategies

In the following section hypotheses are formulated, which emphasize the comprehensive and systematically derived impact of a company's situational context on the dimensions of technology platform strategies. They are based on the understanding of technology platform strategies in section 2 and the internal and external context of a diversified firm, presented in section 3. These hypotheses intend to contribute to the improvement of the integration of a technology platform strategy into diversified companies.

*Hypotheses 1 and 2 about the influence of the technology strategy:*

*H1: An intended pioneer position with regard to the innovation timing promotes a real organization of a technology platform*

The innovation timing, as one of the major decisions points within a technology strategy, can be divided into a possible leadership and follower position (Wolfrum 1994). An innovation leader is considered the first player, implementing a new product idea successfully into the market place (Schuh et al. 2014). Therefore a fast time-to-market, as the time from the beginning of the technology development to the market introduction, is highly relevant. Thus, a technology platform has to deliver the necessary technology development results quickly, in order to support the reduction of this timeframe (Schuh and Ryschka 2015). A real organization encourages the platform employees to share ideas without the use of media and enables them to generate faster results in a physical and dedicated office environment. A real organization for the technology platform will be therefore established, when a pioneer position with regard to the innovation timing is intended.

*H2: The decision to exploit newly developed technologies externally implies to interact closely with the relevant marketing stakeholders*

The technology exploitation decision constitutes one of the most important strategic decisions of a technology strategy (Wolfrum 1994). An external exploitation decision implies that new technological know-how is solely utilized outside the scope of the own company (Schuh et al. 2014). The technology platform employees therefore need to establish a well-organized interconnection with the relevant marketing stakeholders, in order to enhance the fully external exploitation potential of newly developed technologies within a technology platform. In this way, it is guaranteed that the relevant marketing stakeholders can choose the right target markets and communicate between the company and the customer audience.

*Hypothesis 3 about the influence of the company's organizational structure:*

*H3: A highly divisional company structure entails a formal documentation of a technology platform*

A divisional company structure consists of several different business units, usually with a huge amount of employees within these separated entities (Daft 2004). The communication and the knowledge transfer between the different business units is getting more and more complicated with an increasing size of employees and an increasing spatial distance between

the business units (Stig 2013). Higher requirements for the documentation of the knowledge within a technology platform are the consequence (Stig 2013). Thus, the person responsible for a technology platform need to ensure a consistently high quality of knowledge documentation in a divisional company structure for the increased number of possible technology experts. This is way a formal and explicit documentation becomes mandatory for a technology platform in a highly divisional company structure, whereas smaller business with less divisions might potentially still be able to rely on personal knowledge documentation and interaction (Stig 2013). Especially technology catalogs in the form of IT-tools are commonly used in highly diversified companies, in order to offer a structured and standardized possibility for the employees to share their technology related knowledge with colleagues in other parts of the world (Stig 2013).

*Hypotheses 4, 5 and 6 about the influence of the company's culture situation:*

*H4: A strong and commonly accepted company culture is positively influencing the willingness of the single business units to finance a technology platform*

The major problem of a business unit driven financing of technology platforms is due to the fact that business units usually tend to adjust their operations towards their own customer requirements and own technology projects (Rosier 2006). Thus, they often neglect possible synergy potentials and possible standardization opportunities across all the business units within a diversified company (Breuer 2006). However, a strong and commonly accepted company culture shared across all business units is able to unify the individual interests and enhance the understanding for the need of company-wide technological synergies (Ravasi and Schultz 2006). A strong and commonly accepted company culture can be characterized by a mutual horizon of meaning as well as corresponding values and norms that are shared across the individuals within the different business units of a diversified company (Rüegg-Stürm 2005). Therefore, a strong and commonly accepted company culture is potentially beneficial for a joint financing of a technology platform by the individual business units, due to their unifying impact on the decisions of the single business units.

*H5: A company culture characterized by high risk aversion leads to a high intensity of theoretical planning services offered by a technology platform*

A risk culture can be defined as a system of norms and behaviors present in a diversified company that shapes risk decisions of the management and the individual employees (Das and Teng 2001). Therefore, a company culture dominated by risk aversion will lead to a behaviour of individuals that can be characterized by constant attempts to reduce uncertainty in the context of business decisions (Hillson and Murray-Webster 2005). The impact of risk aversion on the range of services offered by a technology platform can be seen in an increased emphasis on theoretical and long-term planning activities of technology projects (Böhlke et al. 2005, De Almeida and Morales 2015). Thus, specific technology projects in a real-life development environment with tangible products or production technology outcomes might be rather not in the prioritized scope of the service range offered by a technology platform for risk averse companies.

*H6: An open innovation culture facilitates the tendency to introduce external technology experts from outside the company into the operational practice of technology platforms*

The open innovation approach refers to the usage of both internal and external ideas and technologies, in order to enhance the input of the research and development pipeline of a company (Chesbrough 2010). As visualized in figure 6, it refers also to the internal and external exploitation of technologies, in order to target the company's current markets as well as foreign or new technology markets (Chesbrough 2010, Cheng and Huizingh 2014).

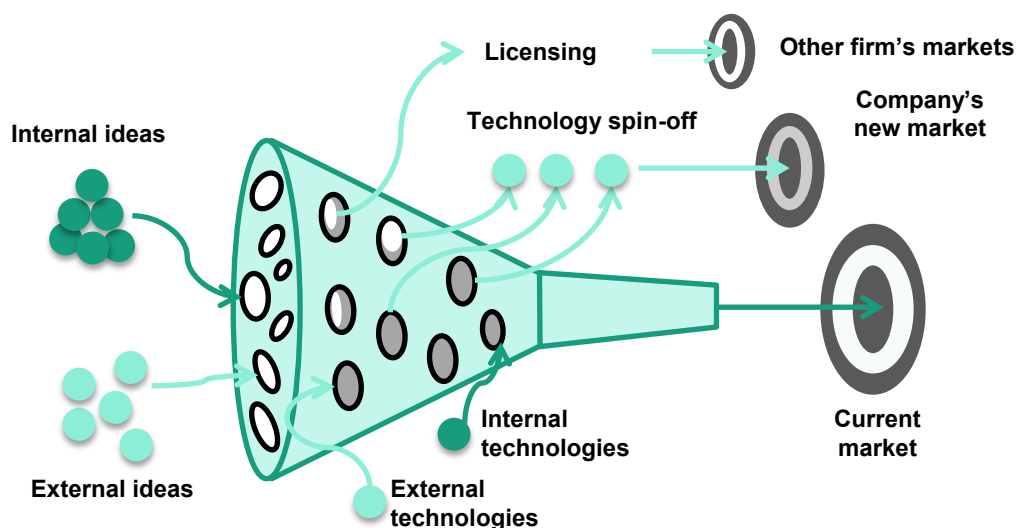


Figure 6: Open innovation funnel (Chesbrough 2010)

Therefore, a companywide open innovation culture is potentially able to affect the human resources of a technology platform in a way that external technology experts might be employed on project basis for a temporary period of time (Stig 2013, Schuh and Ryschka 2015). The external technology experts could support then the internal technology experts in a new technology field until the internal experts are experienced enough to fulfill the required technology platform services autonomously (Rosier 2006).

*Hypotheses 7 and 8 about the influence of the company's resource situation:*

*H7: A high technological level of the production resources entails a close interaction with the relevant production stakeholders*

A high technological level of the internal production resources can be considered as a crucial precondition to obtain a pioneering position in the market entry of technologies (Wolfrum 1994, Brown 2001). Therefore, diversified companies that want to ensure a fast implementation of internally developed technologies will constantly seek for high real investments in their production systems (Brown 2001, Zahra 2002). The technology platform employees within such production driven companies will thus strive to establish a close connection to the production managers within the individual business units, in order to ensure the best possible services for their production systems.

*H8: A highly educated human resource base tends to result in an informal documentation of the technology platform knowledge*

A highly educated human resource base within a technology intensive work environment is often characterized by the ability to act and think interdisciplinary during daily work tasks (Feucht 1996). In that way, an efficient operation of cross-functional and cross-organizational technology project teams can be established within a technology platform (Farris and Chen 2010). The establishment of such project teams has the potential to reduce the amount of formal knowledge documentation, because the workforce is potentially more able to directly communicate and understand technological questions by face-to-face communication or workshops, due to their interdisciplinary thinking (Stig 2013). Thus, the need for the installation and the maintenance of formal knowledge documentation systems is not as high as with a lower educated human resource workforce, because of their ability to think interdisciplinary during technology platform projects.

*Hypotheses 9 and 10 about the influence of the company's market-specific environment:*

*H9: A high intensity of price competition can lead to a more centralized financing of technology platforms through corporate budget*

A high intensity of competition affects the profits and the resource situation of a diversified company in an negative way (Porter 1998). Especially in case of a price competition, profits are cut down to a minimum, since the distinction of the final products or services is solely based on price and no other distinguishing factors like the underlying technologies (Brue and McConnell 2002). Business units that are in general more short-term oriented and more focused on specific solutions for particular markets than the corporate level, do not tend to share their resources and technologies in such a situation with other business units (Breuer 2006, Rosier 2006). As a possible tendency, technology platforms are thus financed less by the business units in case of price competition. This is why central corporate budget needs to be used to a higher extend, in order to maintain the synergetic range of services of technology platforms during price competition.

*H10: A high threat of substitute products tends to result in focusing on technology intelligence activities within the technology platform*

Diversified companies can potentially experience a high threat of substitute products, because of their many business units (Daft 2004). Substitute products are products from different industries that can perform the same function as the product produced by the firms within the industry (Porter 1998). The most relevant substitute product for technological driven, diversified companies are products that are subject to technological trends in different industries, improving the price-performance tradeoff with the industry's product, due to new technological advances (Porter 1998). Technology intelligence, as an activity of technology management, enables to identify new technological opportunities and threats that could potentially affect the future growth of diversified companies, due to the substitution of their products (Ashton and Klavans 1997). Thus, technology intelligence activities will be focused, in case of a high threat of substitute products, in order to constantly detect technological threats and identify technological opportunities for the threatened products.

### Conclusion and future research

In this paper we developed a model, in order to illustrate the influence of a diversified company’s situational context on technology platform strategies. From a practical as well as a theoretical point of view there is a high need for coordination between the situational context of diversified companies and the integration of technology platform strategies. In total, 10 hypotheses have been formulated, which specify the influence of the of particular situational context factors on elements of a technology platform strategy. As visualized in figure 7, 8 out of the 10 hypotheses are specifying the influence of the internal context of diversified companies on technology platform strategies, whereas the remaining 2 hypotheses detail the influence of the external context on technology platform strategies.

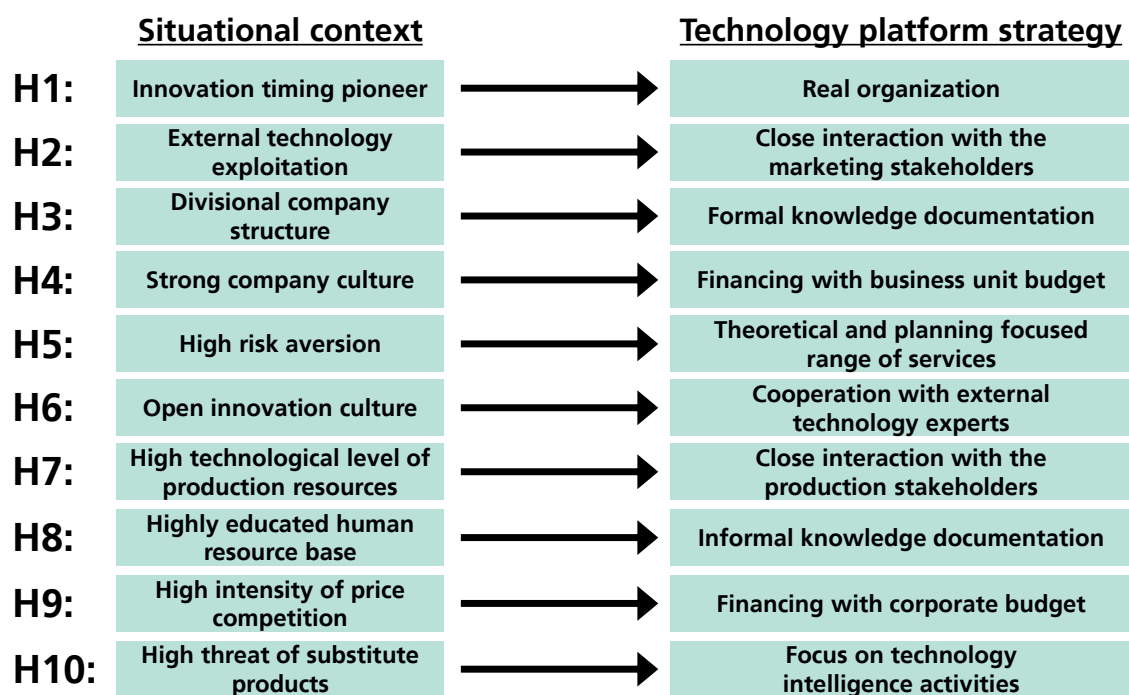


Figure 7: Hypotheses about the influence of the situational context of diversified companies on the strategic elements of technology platforms

The outcomes of this research paper emphasize the importance to systematically align the situational context of diversified companies with the strategic elements of technology platforms. Thus, specific points of integration between the situational context of diversified companies and the strategic elements of technology platforms are presented in this research paper for the employees in diversified companies, who are responsible for developing and integrating technology platform strategies.

Further research is needed to expand and validate the derived hypotheses. Empirical studies should be conducted to consistently validate the proposed hypotheses. Furthermore, the analysis of a company’s situational context could be extended to the global environment of a diversified company. Such an investigation would further promote a coordinated integration of technology platform strategies within the situational context of diversified companies.



## References

- Ashton, W and Klavans, R (1997). An introduction to technical intelligence in business. In *Keeping Abreast of Science and Technology. Technical Intelligence for Business*, W Ashton and R Klavans (eds.), pp. 5-22. Columbus: Batelle Press.
- Bamberger, I and Wrona, T (2004). *Strategische Unternehmensführung*. München: Vahlen.
- Bea, F and Haas, J (2005). *Strategisches Management*. Stuttgart: Lucius & Lucius.
- Berglund, F, Bergsjö, D, Högman, U and Khadke, K (2008). Platform strategies for a supplier in the aircraft engine industry. In *Proc. ASME 2008 Int. Design Engineering Technical Conf. & Computers and Information in Engineering Conf.*, pp. 55-66. Brooklyn: ASME.
- Böhlke, UH, Breuer, T, Dahlmann, P, Demarmels, A, Koglin, K, Pelzer, W, Riediker, M, Rosier, C, Schick, R, Schröder, J, Schuh, G, Spohr, GU (2005). Technologieplattformen erfolgreich managen – Ein essentieller Beitrag zur Umsetzung der Unternehmensstrategie. In *Aachener Werkzeugmaschinenkolloquium*, C Brecher (ed.), pp. 393-415, Aachen: Shaker.
- Breuer, T (2006). *Management von Technologieplattformen in diversifizierten Unternehmen*. Aachen: Shaker.
- Brown, S (2001). Managing Process Technology. Further Empirical Evidence From Manufacturing Plants. *Technovation*, 21(8), 467-478.
- Brue, S and Mc Connell, R (2002). *Economics in Principles, Problems and Policies*. Boston: Irvin/McGraw-Hill.
- Castelfranchi, C (2007). Six critical remarks on science and the construction of the knowledge society. *Journal of Science Communication*, 6(4), 1-3.
- Chandler, AD (1995). *Strategy and structure*. Cambridge, Mass.: MIT Press.
- Cheng, CCJ and Huizingh, EKRE (2014). When is Open Innovation Beneficial? *Journal of Product Innovation Management*, 31(6), 1235-1253.
- Chesbrough, HW (2010). *Open innovation*. Boston, Mass.: Harvard Business School Press.
- Chiesa, V (2001). *R&D Strategy & Organization: Managing Technical Change in Dynamic Contexts*. London: Imperial College Press.
- Daft, RL (2004). *Organization Theory and Design*. Mason: South-Western.
- Das, TK and Teng, BS (2001). Trust, Control, and Risk in Strategic Alliances: An Integrated Framework. *Organization Studies*, 22(2), 1-29.
- De Almeida, MF and De Moraes, CAC (2015). Designing a Technology and Innovation Platform for Oncological Drugs: An Integrated Foresight Framework. In *Proc. 24th Int. Conf. Management of Technology*, pp. 1990-2010. Cape Town, South Africa.
- Drucker, PF (2001). *The Essential Drucker*. New York: Harper Business.

- Farris, GF and Chen, YY (2010). Human Resources in R&D. In *Encyclopedia of Technology & Innovation Management*, VK Narayanan and GC O'Connor (eds.), pp. 149-155, Chichester: Wiley.
- Feucht, H (1996). *Implementierung von Technologiestrategien*. Frankfurt am Main: Lang.
- Floyd, SW and Wolf, C (2010). Technology Strategy. In *Encyclopedia of Technology & Innovation Management*, VK Narayanan and GC O'Connor (eds.), pp. 125-129, Chichester: Wiley.
- Ford, D (1988). Develop your Technology Strategy. *Long Range Planning*, 21 (5), 85-95.
- Ford, D and Saren, M (2001). *Managing & Marketing Technology*. London: Thomson Learning.
- Grant, RM (2005). *Contemporary Strategy Analysis*. Malden: Blackwell.
- Hillson, D and Murray-Webster, R (2005). *Understanding and Managing Risk Attitude*. Farnham: Gower Publishing.
- Hofer, CW and Schendel, D (1978). *Strategy formulation*. St. Paul: West Publishing.
- Högman, U (2011). Processes and platforms aligned with technology development. The perspective of a supplier in the aerospace industry. Unpublished doctoral dissertation, Chalmers University of Technology, Dept of Product and Production Development.
- Hungenberg, H and Wulf, T (2011). *Grundlagen der Unternehmensführung*. Berlin: Springer-Verlag.
- Jolly, DR and Nasiriyar, M (2007). Technology platform exploitation: definition and research boundaries. In *Proc. 16th Int. Conf. Management of Technology*, Miami, USA.
- Katz, R and Allen, TJ (1982). Investigating the Not Invented Here (NIH) syndrome. *R&D Management*, 12 (1), 7-20.
- Kieser, A and Walgenbach, P (2003). *Organisation*. Stuttgart: Schäffler-Poeschel.
- Kotter, JP and Heskett, JL (1992). *Corporate Culture and Performance*. New York: Free Press.
- Levandowski, CE, Corin-Stig, D, Bergsjö, D, Forslund, A, Hogman, U, Soderberg, R and Johannesson, H (2013). An integrated approach to technology platform and product platform development. *Concurrent Engineering*, 21(1), 65-83.
- Macharzina, K and Wolf, J (2010). *Unternehmensführung*. Wiesbaden: Gabler.
- McGrath, ME (2000). *Product strategy for high-technology companies*. New York: McGraw-Hill.
- Mintzberg, H (1978). Patterns in Strategy Formation. *Management Science*, 24(9), 934-948.
- Mintzberg, H, Ahlstrand, BW and Lampel, J (1998). *Strategy safari*. New York: Free Press.
- Müller-Stewens, G and Lechner, C (2003). *Strategisches Management*. Stuttgart: Schäffler-Poeschel.
- Nasiriyar, M (2010). Technological platforms, Business Diversification and Performance. Unpublished doctoral dissertation, Université Paul Cézanne Aix-Marseille III.

- Porter, ME (1991). Towards a dynamic theory of strategy. *Strategic Management Journal*, Special Issue, 12 (S2), 95-117.
- Porter, ME (1998). *Competitive Strategy*. New York: Free Press.
- Porter, ME (2001). Strategy and the Internet. *Harvard Business Review*, 79 (3), 62-78.
- Ravasi, D and Schultz, M (2006). Responding to organizational identity threats: Exploring the role of organizational culture. *Academy of Management Journal*, 49(3), 433-458.
- Roberts, EB (2001). Benchmarking Global Strategic Management of Technology. *Research Technology Management*, 44(2), 25-36.
- Rosier, C (2006). *Zentrale Technologieentwicklung in diversifizierten Unternehmen*. Aachen: Shaker.
- Rudolf, S (2013). *Produktionsgerechte Baukastengestaltung*. Aachen: Apprimus Verlag.
- Rüegg-Stürm, J (2005). *Das neue St. Galler Management-Modell*. Bern: Haupt.
- Schreyögg, G (2008). *Organisation*. Wiesbaden: Gabler.
- Schuh, G, Arnoscht, J, Bohl, A and Nussbaum, C (2011). Integrative Assessment and Configuration of Production Systems. *CIRP Annals Manufacturing Technology*, 60 (1), 457-460.
- Schuh, G and Drescher, T (2014). Systematic leverage of technological assets: A case study for automated tissue engineering. *Journal of Engineering and Technology Management*, 32(April-June 2014), 76-96.
- Schuh, G and Ryschka, S (2015). Strategy framework for technology platforms within the context of diversified companies. In *Proc. IEEE Int. Conf. Industrial Engineering and Engineering Management*, pp. 1514-1519. Singapore: IEEE Press.
- Schuh, G, Guo, D, Wölk, S, Ryschka, S and Schön, N (2014). Strategische Technologieplanung: Von der Strategie über die Roadmap zur Plattformentwicklung. *IM+io Management*, 2 (3), 49-64.
- Schultz, C (2011). Die Finanzierung technologieorientierter Unternehmen in Deutschland. Empirische Analysen der Kapitalverwendung und -herkunft in den Unternehmensphasen. Wiesbaden: Gabler.
- Shapiro, AR (2006). Measuring Innovation: Beyond Revenue from New Products. *Research Technology Management*, 49(6), 42-51.
- Stig, DC (2013). A Proposed Technology Platform Framework to Support Technology Reuse. In *Proc. Conf. Systems Engineering Research*, CCJ Paredis and D Bodner (eds.), pp. 918-926. Atlanta: Procedia Computer Science.
- Tyson, S (1997). Human Resource Strategy. *The International Journal of Human Resource Management*, 8(3), 277-290.
- Wolfrum, B (1994). *Strategisches Technologiemanagement*. Wiesbaden: Gabler.
- Zahra, SA and Nielsen, AP (2002). Sources of Capabilities, Integration and Technology Commercialization. *Strategic Management Journal*, 23(5), 189-219.