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Towards an ambidextrous innovation management maturity model

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Abstract

Digitalization is leading to wide-ranging changes for the economy and is considered as one of the main drivers of innovation. Ever-shorter innovation cycles, high volatility and increased cost pressure are just some of the effects that companies have to face as a result of digitalization. In order to remain competitive in the long term, companies not only have to continuously develop existing products and services, but also exploit the innovation potential of new technologies. This poses new challenges for innovation management, since the company must work on the development of radical or even disruptive innovations in addition to the popular development of incremental innovations. The simultaneous promotion of incremental and radical innovations is also known as ambidexterity. The development of incremental innovations has been established for years in most companies. However, many companies do not have the required know-how about the development of radical innovations and the realization of ambidexterity. One important step on the way to an ambidextrous innovation management is the analysis of the initial situation in the company. Often there is uncertainty about which areas and tasks have to be considered and should be designed in the sense of ambidexterity. Therefore, this paper develops a maturity model for an ambidextrous innovation management. For this purpose, a systematic literature analysis of existing maturity models in innovation management will be conducted and its understanding of innovation will be compared. Since most maturity models do not explicitly differentiate between radical innovations or primarily consider incremental innovations, requirements for the innovation management of radical innovations and ambidexterity were derived in the course of a further systematic literature analysis. Based on this database, a maturity model for an ambidextrous innovation management could be derived, which is subdivided into 26 tasks with 5 different levels each.

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1. Overview

The digitalization that accompanies Industry 4.0. holds an enormous potential for innovation [1]. Therefore, it becomes increasingly important for manufacturing companies, not only to optimize existing products through incremental innovations, but also to promote the development of new products through radical and even disruptive innovations, which are able to replace existing technologies overnight. [1,2,3]. The potential of a company to promote both incremental and radical innovations is described by the term

ambidexterity [3,4]. In order to remain competitive, companies have to focus their innovation management to the characteristics of digitalization and the resulting need of an ambidexterity [1,4].

However, many companies are not sure about the possibilities (design fields and related tasks) of ambidexterity while transforming their innovation management. There is also often uncertainty regarding the currently predominant innovation management in the company. For this reason, a maturity model is needed, which shows the status quo of ambidexterity in the innovation management of a company.

2. Effects of digitalization and challenges for innovation management

Digitalization integrates increased networking, therefore the use of **digital platforms** and the connection of physical products through networks like the **internet of things** (IoT). This forms the basis for various intelligent systems and applications in various areas (**Smart Services**). The use of **artificial intelligence** is also increasing. The constant generation and use of data by humans, machines and processes also results in a **high volume of data** (Big Data) [1,5,6,7].

As a result of these effects, various challenges arise for companies in the context of innovation management. First of all, existing innovation processes often prove to be too rigid and time-consuming for the implementation of ideas for **digital market services** [2,7]. At the same time, the rapid distribution of data leads to an increasingly **knowledge-based value creation** and a faster distribution and establishment of new products, which **accelerates innovation cycles** and shortens them overall [2,5,8,9]. This shortening also results from a faster distribution and establishment of new products, which leads to a **shortening of product and technology life cycles** [2,5,10]. The **rapid technological progress** brought by digitalization leads to an increasing number of innovative products [11]. In addition, **customer demands** are becoming **less static** and predictable as a result of digitalization, as they evolve in line with rapidly changing markets [12]. Increasing networking also goes along with new revenue models that go beyond mere sales and are based on service, which are characterized by continuous interaction with the customer [2]. In general, digitalization is leading to a **reorganization of existing markets** and an enormous **disruptive change**. This makes it necessary for companies to establish an increasing ability to adapt to changing conditions. They must make the development of innovations more efficient, otherwise they must fear being forced out of the market by disruptive innovations due to **reduced market entry barriers** [2,10].

Various trends have emerged in recent years to meet the challenges of digitalization described above. For example, the implementation of innovation in external organizational units, so-called **Digital Innovation Units**, outside the actual organizational structure has proven its effectiveness [9]. **Open innovation** is also a good way of opening up the innovation process to external partners such as universities or other companies, so that the knowledge needed to generate innovations is no longer created exclusively within the company. [2,9,13,14]. The use of agile methods helps to enable greater flexibility and reaction speed with regard to the changed requirements resulting from digitalization [2,8]. A further trend is the increasing use of digital business and service models [2].

3. The role of ambidexterity for companies

The term ambidexterity generally stands for an equally developed dexterity of both hands [15]. In the corporate context, ambidexterity means that a company is able to promote both **exploitation** and **exploration**, in order to be able

to generate both incremental and radical innovations [4,15,16]. Exploitation in this context means the exploitation of previous knowledge or technologies, while exploration stands for the research of new solutions. The literature shows that an ambidextrous design of a company is associated with positive effects on sales growth, company performance, market value and corporate success. There is also a positive correlation with increased innovative strength, better financial performance, and higher survival rates of organizations [16].

For the implementation of ambidexterity in the organization, there are different forms of design: **Sequential ambidexterity**, **structural ambidexterity**, **contextual ambidexterity**, and **hybrid ambidexterity** [4,16]. With the sequential procedure, a temporal change of company divisions between explorative and exploitative activities occurs according to the strategy of the company or as an adaptation to environmental changes. Considering the rapid technological change, companies fear the ineffectiveness of such a procedure. Organizations must be simultaneously active in explorative and exploitative activities as fast as possible and not alternately. This serves as a basis for the approach of **structural ambidexterity**, in which autonomous, structurally separate corporate units for exploitation and exploration are created with their own orientation regarding structures, processes and innovation culture [4,16,17]. The separate entities are held together by a common strategic intent, an overarching set of values, and specific linking mechanisms for the use of shared assets [16,17,18]. The **contextual ambidexterity** approach involves designing structures and processes in an organization in a way that allows individuals to decide how to divide their time between exploratory and exploitative activities depending on the context [4,16,19]. This approach requires that each employee must have the appropriate skills to act both exploitatively and exploratively [4]. In general, organizations tend to implement ambidexterity essentially through a combination of structural and contextual aspects as well as on an organizational and interorganizational level, rather than through a single form of ambidexterity alone [20]. An approach in which a combination of purely explorative or exploitative units on the one hand and units of contextual ambidexterity on the other hand is called **hybrid ambidexterity** [4].

4. Established maturity models in innovation management

Maturity models are originated in the fields of business informatics, quality management and software development, but are now widely used in various areas. Their aim is to represent the **current state** of a certain situation or its maturity and thus to make a performance assessment. Furthermore, potentials for **performance improvement** are identified by showing possible improvement potentials for achieving a desired target state. The degree of fulfillment of the desired target state is shown by means of **maturity levels** that are based on each other [21,22,23,24,25]. So far, there are only a few maturity models being dedicated to the field of innovation management. These are specifically the models of Bürgin, Nauyalis, Khan and Demir as well as the "Strategyzer Innovation Readiness Assessment" [[21,26,27,28,29].

The models have in common that they are intended to serve as a tool for companies to analyze an existing innovation management and to evaluate the performance of different aspects. Differences arise in particular with regard to the level of detail and the associated clarity and comprehensibility. Especially the models of Bürgin and Khan include a high number of investigated dimensions, which in turn are subdivided into a multitude of individual elements or aspects to be studied. These are all examined individually with regard to their maturity within innovation management, which leads to a high degree of complexity and makes it difficult to understand [21,26]. In contrast, the models of Nauyalis and Demir as well as the "Strategyzer Innovation Readiness Assessment" are presented entirely in a tabular overview. Although they also include various dimensions to describe innovation management, these are not further subdivided into individual aspects. As in the case of the "Strategyzer Innovation Readiness Assessment", only into three more precisely defined sub-aspects [27,28,29]. Although these approaches are associated with an easier comprehensibility and clarity, the analyzed dimensions are evaluated rather generally and not with regard to different possible influencing factors.

Analyzing all the mentioned/different aspects, one can conclude that none of the existing maturity models include the aspect of ambidexterity and take into account the effects of digitalization.

5. Requirements for ambidexterity in a company

A multitude of requirements for an ambidextrous innovation management can be found in the literature, which have to be considered when developing a maturity model for an ambidextrous innovation management.

5.1 Requirements for the innovation process

While designing the innovation process, it is important to note that impulses for innovation should not only be sought internally within the company, but that greater attention should be paid to capturing external impulses, which plays an important role in promoting both exploitation and exploration. Thus, external cooperations usually offer additional knowledge and skills through the know-how of partners, which is accompanied by additional potential for radical idea generation. Exploratory cooperations are possible with universities, research institutes or innovative companies. In terms of exploitation, cooperation with customers or suppliers can lead to increased efficiency and release of capital [20]. The integration of customers is also essential in the context of digitalization and the associated constantly changing and less predictable customer requirements [12].

5.2 Requirements for the innovation strategy

For the development of an ambidextrous innovation strategy, it is necessary to define the different directions of exploitation and exploration in a common strategic intention as well as in superordinated values. The purpose of defining a clear strategic intent is to justify the importance of exploitation

and exploration for the future competitiveness of a company, in order to promote a commitment in the sense of ambidexterity within the company [18]. In this sense, a clear and convincing common vision has to be established, which enables the coexistence of exploitation and exploration, emphasizes the strategic necessity of ambidexterity and its benefits for all employees, and thus establishes common values and a common identity [17,18,30,31]. In order to communicate the innovation strategy and its necessity within the company, an integrative management team is necessary. This team has the task of managing the contradictions of the ambidextrous orientation and resolving the resulting tensions and conflicts by responding equally to the different needs of the various organizational units and managing inconsistent organizational orientations [18,30].

5.3 Requirements for the innovation organization

In order to establish ambidexterity with regard to the organization of innovation, it is first and foremost necessary to make a decision about the form of design of ambidexterity (scf. Section 3.)

Organizational separation enables companies to continue their established business and to generate radical innovations in separate organizational units [18,30]. It is important to consider different processes, structures and capabilities for exploitation and exploration. In terms of contextual ambidexterity, individual employees should be encouraged to decide how to flexibly divide their time between exploitative and explorative activities as part of their daily work [19,32]. However, it should be considered that ambidextrous action cannot be demanded in general and equally from all employees. Rather, it is necessary to consider the different weightings of exploration and exploitation in different departments, which means that the requirements for the respective employees are different. Therefore, a balanced coordination of resources is required to establish ambidexterity. In order to meet the challenges posed by digitalization, both the above-mentioned aspects of structural and contextual ambidexterity in the company can be taken into account in the hybrid design of ambidexterity in innovation management [4]. The dynamic capabilities of the organization is important to establish ambidexterity. In addition to the internal implementation of ambidexterity in innovation management, cooperation with external partners should also be considered, as these have proven to be particularly effective in generating radical innovations [20].

5.4 Requirements for the innovation culture

When developing an ambidextrous innovation culture, it should be taken into account that this culture is primarily reflected in unwritten behavior and routines [32]. For example, it is important to ensure that the culture is strictly defined in terms of desired norms such as openness, autonomy, initiative and willingness to take risks, but that it should also be loose in the sense that the design of these values can be varied according to the type of innovation required. Autonomy and risk-taking can be fostered by autonomously structured business units that give employees a sense of personal responsibility for their results [17]. In addition to communicating the innovation strategy, an integrative management team described above is

also responsible for implementing an incentive and reward system throughout the company [18]. On an individual level, ambidextrous behavior such as initiative, creativity and openness to new opportunities should be encouraged among employees [4,32]. To achieve this, employees must be informed and motivated so that they are able to act spontaneously and without instructions from superiors [32].

6. Maturity Model for an ambidextrous Innovation Management

Based on the identified requirements, various tasks in the implementation of ambidexterity can be identified within the six design fields Impulses for Innovation, Idea Generation, Idea Implementation, Innovation Strategy, Innovation Organization and Innovation Culture. The design fields result from a previously developed reference model [33]. For the individual tasks, corresponding maturity levels can be determined to evaluate their fulfillment.

In total, 26 different tasks were identified. Within the design field Impulses for Innovation, the tasks in question are the implementation of market analyses, identification of customer needs, identification of technology potentials, identification of internal optimization potentials and promotion of external impulses. For the design field of Idea Generation the tasks intuitive generation of ideas, discursive generation of ideas, evaluation of ideas and inclusion of market and technology-induced impulses can be defined. The design field Idea Implementation comprises the two tasks planning of Idea Implementation and validation of ideas. In the context of the design field Innovation Strategy, the tasks of establishing concrete innovation tasks in the Innovation Strategy, integrating ambidexterity in the Innovation Strategy, ensuring the adaptability of the innovation strategy to changing requirements, and building an integrative management team must be taken into account. The design field of Innovation Organization includes the tasks of designing the innovation process, establishing a structured idea management system, setting up a structured knowledge management system, creating free time, including R&D cooperations and organizational implementation of ambidexterity in innovation management. The design field of Innovation Culture includes the tasks of promoting the willingness to experiment, communication and fault tolerance, creating an environment that promotes creativity, creating incentive systems, promoting the development of competencies and promoting diversity and the reduction of hierarchies [33,34,35].

For each of the 26 tasks, five possible maturity levels are described, ranging from exploitation to exploration. A classification on the level exploration corresponds to the realization that the considered task is solved primarily exploitatively in the examined enterprise. This corresponds to the generation of incremental innovations, while a classification at exploration stands for the fact that the task is solved exploratively and in the sense of the generation of radical innovations. The optimum for ambidexterity within this task is the balance between explosive and explorative aspects.

To give another example, the task of conducting market analysis, within the design field of impulses for innovation will

be described in the following. Within its scope it is necessary to determine which markets and competitors a company considers in the course of its market analyses. Important information that a company should determine about its competitors is, above all, their current product portfolio compared to the company's own range of products and services, as well as their strategic orientation and global presence [34]. Possible sources for obtaining this information can be primary sources such as competitors' websites or their profiles in social networks. Secondary sources are in particular company databases and industry-specific trade journals. Another possibility for obtaining information is the evaluation of annual reports. Furthermore, market studies can be used as sources [36,37]. For the systematic execution of market analyses, different methods can be used, e.g. a SWOT analysis, with which strengths and weaknesses as well as chances and risks of the enterprise and the competitors can be compared [38]. In order to ensure a clear investigation and documentation of all competitors as well as their comparability, it is advisable to document generated information about competitors in competitor profiles [34].

In general, companies tend to base their market analyses on existing products and markets and thus on the immediate expectations of their customers [39]. This results from the fact that existing markets are associated with fewer difficulties in terms of customer research and forecasting, and means that companies often have longstanding experience in their established markets. This strong focus on the analysis of existing markets usually results in companies generating predominantly small, incremental innovations [40,41]. This can result in radical developments and trends being overlooked and companies having long-term problems in maintaining their position in changing markets [39,40,42]. In addition, the analysis of the competition and the industry largely takes into account existing competitors within the industry, while potential competitors outside the industry who could potentially enter the market are neglected [43,44]. In the course of the predominant concentration on the analysis of existing markets, there is also the risk that little or no resources are used for the analysis of disruptive potentials in initially small and unattractive looking markets. In addition, companies usually apply methods that are suitable for the evaluation of existing markets but are only of limited use for the analysis of new markets [40].

As a result, companies tend to focus their market analysis in favor of existing markets and impulses for incremental innovation, which leads to the fact that less developed and thus even less attractive markets and the potential for radical innovation impulses are neglected. It is therefore important to create a balance in the course of the market analysis with regard to the analysis of established and emerging markets [41]. Due to the growing challenges posed by digitalization, market analysis must take into account the relevant trends and their effects [45].

Based on these findings, the five maturity levels described above can be worked out for the task in question. If a company exclusively concentrates on the monitoring of direct competitors and only conducts research on known competitors, it fulfils the task exclusively in terms of exploitation and

therefore forces incremental innovation. If, in addition to its own industry, potentially new and emerging markets and the companies operating in them are also investigated, a rating of predominantly exploitation is to be made. The other extreme is an exclusive analysis of new markets and the companies from other industries operating in these markets, which represents a solution of the task in the context of an exclusively exploration and therefore radical. With an additional inclusion of intra-industry competitors in the competition analysis, a classification on level predominantly exploration can be made. To achieve a solution of this task in the sense of an ambidextrous innovation management, a company has to examine competitors in existing markets and identify potentials and competitors in possible new and emerging markets. In addition, comprehensive market analysis methods should be used, and the results generated should be systematically documented. The different stages of maturity of the task of conducting market analyses are visualized in Figure 1.

Task 1: Execution of market analyses				
How is the task "Execution of market analyses" handled in the considered company?				
Exploitation	Predominantly Exploitation	Ambidexterity	Predominantly Exploration	Exploration
EXPLOITATION			EXPLORATION	
The execution of market analyses focuses on the observation of competitors within the own industry as well as known markets.	The execution of market analyses focuses on the observation of competitors within the own industry as well as known markets... ...occasionally, research is conducted into potential new markets for the market services we offer.	The execution of market analyses focuses on the observation of competitors within the own industry as well as known markets... ...as well as potential competitors, new potential markets and trend developments. The effects of trends are anticipated at an early stage and the business is adjusted accordingly.	Competitors in the same industry are kept in mind but not explicitly analyzed... ...as well as potential competitors, new potential markets and trend developments. The effects of trends are anticipated at an early stage and the business is adjusted accordingly.	...as well as potential competitors, new potential markets and trend developments. The effects of trends are anticipated at an early stage and the business is adjusted accordingly.

Figure 1: the maturity levels for the task "Execution of market analyses"

The targeted optimum for each task is the level of ambidexterity, which stands for a solution of the task in the sense of an ambidextrous innovation management, in which both exploitation and exploration are focused.

Figure 2 shows a schematic representation of the entire maturity level model, in which all task profiles are listed. If evaluations were made for all 26 tasks, a company subsequently has an overview about the ambidexterity in each task. The overall picture represents the ambidexterity profile of

the company. It thus serves as a basis for identifying the design fields and Tasks with the greatest potential for optimization.

Design Fields	Tasks	Ambidexterity of the innovation management				
		Exploitation	Predominantly Exploitation	Ambidexterity	Predominantly Exploration	Exploration
Impulses for innovation		EXPLOITATION			EXPLORATION	
Idea generation						
Idea implementation	26 Tasks					
Innovation organization						
Innovation culture						

Figure 2: Structure of the maturity model for an ambidextrous innovation management

7. Summary and outlook

This paper described a maturity model for the investigation of an innovation management regarding the aspect of ambidexterity. The necessity of this maturity model is justified by the effects and resulting challenges of digitalization for the innovation management of companies.

Based on the literature, different requirements of ambidexterity for the design fields of innovation process, strategy, organization and culture were derived. In further steps they form the basis for the elaboration of concrete tasks within the maturity model. The analysis of established maturity models in innovation management show, that none of them fulfill the necessary requirements. Thus, this paper shows an assessment tool to evaluate the current status of ambidexterity in the innovation management, which is based on 26 tasks that belong to six different design fields. Each task can be managed in an exploitative, explorative or ambidextrous way. These different possibilities are described in detail for each task. The compliance with the different designs of the tasks show the company's current status of ambidexterity in every design field of the innovation management.

In the course of further research, there are various possibilities for further developing the maturity model for ambidextrous innovation management. It is possible to make the maturity model more flexible in a way where the individual design fields and tasks can be weighted differently according to the needs of the company under investigation and thus prioritized to a greater or lesser extent. In this way, the maturity model can be flexibly adapted to the needs of a company and its environment, enabling a more individual evaluation and assessment as well as a focus on aspects that are particularly important for a specific company. It is also conceivable to set up a guideline for optimizing the design of the individual tasks, in which, concrete possible methods or design options are compiled which can help companies to solve a task more exploratively or more exploitatively, depending on the direction in which it must optimize itself in order to achieve ambidexterity within the framework of this task.

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