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MANAGING DISRUPTIVE INNOVATION BY VALUE-ORIENTED PORTFOLIO PLANNING

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Abstract

Innovation portfolio management (IPM) aims at selecting ideas with regard to their potential for innovation and measuring them considering customer and business value. The evaluation of benefits and risk is especially challenging for disruptive innovation (DI) due to their characteristics such as low comparability to existing technologies and uncertain customer reactions. This paper highlights the lack of approaches to managing DI in IPM and addresses it through a framework that expands the understanding of value-orientation in IPM, allowing for the inclusion of DI.

Keywords: portfolio management, innovation management, innovation, disruption, customer value

1. Introduction

Rapidly evolving markets and increasing customer demands force firms to provide value promptly and comprehensively. This complex environment fosters innovative ideas with high novelty and uncertainty. Therefore, the possibility for disruptive innovation (DI) increases. Disruption is a threat especially for established firms that disregard disruptive trends and may be displaced by small entrants (Christensen, 1997). This raises the question of whether firms can use disruptive trends as an opportunity to develop innovations with disruptive potential themselves to become the disruptor and not the disrupted.

The failure of Kodak, who miscalculated the potential of digital cameras, is a commonly used example of the effects of DI. The tragedy of this story is that Kodak itself invented the digital camera. So, there came a time when Kodak decided to continue developing the then lucrative analogue camera and decided not to bring the digital camera to market maturity (Estrin, 2015). In order to protect other firms from the same fate, the question arises how the portfolio manager can be supported in evaluating the innovation potential, especially of the firm's own new product ideas.

In the early stages of product development, innovation portfolio management (IPM) serves to identify the potential of innovation projects derived from new product ideas to create a portfolio of a firm's most promising projects (Cooper et al., 2001). Portfolio project evaluation and selection is challenging due to high uncertainty of DI and low comparability to existing projects. Here, the risk exists that potentially DI may be eschewed in favour of sustaining innovations (SI) that are easier to evaluate due to their predictability, as they represent further development of existing products. Consequently, the question arises how DI can be valued. Many authors tried to evaluate innovations regarding their value (e.g. Cooper et al., 2001; Mathews, 2011) and multifaceted definitions of value are provided, especially from a business and customer perspective (Killen et al., 2008). Because of the variety of

definitions, research highlights a need for guidance on understanding value and to find ways to comprehensively identify and measure portfolio value (Martinsuo and Killen, 2014).
On this basis, this paper aims to explore how value orientation can be used to evaluate and follow up DI in IPM (Figure 1). In the following, the relevant and considered topics are explained.

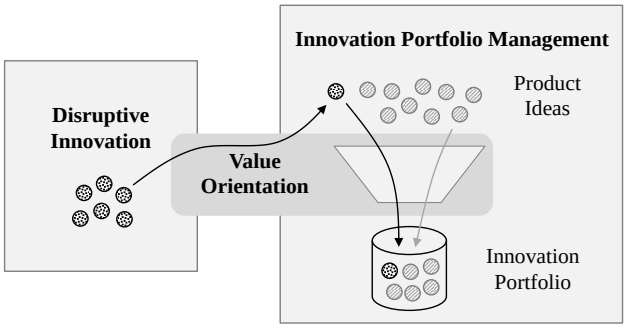

Figure 1. Managing DI by value-oriented IPM

1.1. Relevant research fields

Christensen (1997) distinguishes between SI that are understood as an incremental or radical improvement of existing products and *disruptive innovations* that offer new performance criteria using new technologies and have an impact on the market environment. DI may become threatening for firms that over-focus on lucrative SI. Especially established firms may fail to identify emerging DIs or their possibility to erode the firm's market share. Disruption happens when the innovation gains market share from firms which are not well prepared for the unexpected attack (Christensen, 1997).
Innovation portfolio management can be described as a dynamic decision process, whereby a business' list of active new products and R&D projects is constantly updated and revised. Here, new product ideas are evaluated, prioritized and selected and resources are allocated among the projects (Cooper et al., 1999). Studies confirm that IPM is critical for a firm's success due to its focus on the 'right' high value projects (Killen et al., 2008; Chao and Kavadias, 2008).
Value can be understood as a customer's perceived preference for product attributes and consequences arising from use that promote achieving customers' goals in use situations (Woodruff, 1997). In his hierarchy model for customer value, Woodruff (1997) defined three levels of customer value: Customer goals (1) determine use situations (2) which influence the way customers perceive product attributes (3). DI also address customer's goals and use situations when delivering new performance criteria (Christensen and Raynor, 2003; Schimpf, 2019).

1.2. Research focus, methodological approach and outline

The intention of this paper is to outline and develop a basic understanding of how DI can be integrated into IPM. In this contribution DI are understood as potentially disruptive product ideas that firms might or might not include in their IPM. These ideas are identified by customer needs and market requirements (market pull) or are the result of the innovative ability of firms (technology push). Therefore, this contribution does not focus on the identification of product ideas, but on their potential and its evaluation. The following questions are discussed and answered:

- How can the disruptive potential of product ideas be identified and included in their evaluation?
- How should IPM frameworks be modified to comprehensively account for DI?

For this reason, the current status in research is presented, in particular with regard to the characteristics of DI and implications for their management and the use of value orientation in current IPM approaches (sec. 2). On this basis, requirements for the identification and evaluation of the disruptive potential of product ideas in IPM are derived (sec. 3). Then, current approaches in research are analysed regarding their requirement fulfilment (sec. 4). A framework is developed based on the findings of the literature analysis and an outlook for further research is given (sec. 5). This contribution follows the Design Research Methodology of Blessing and Chakrabarti (2009) and can be classified in its Descriptive Study

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I, which aims to conduct a systematic literature review and research needs with the intend to provide a framework for the development and operational methodology for managing DI in IPM.

2. State of the art

2.1. Managing disruptive innovation

To identify and manage DI, understanding their characteristics and relevance is crucial. Firms assign most of the resources to developing features with a view of serving their mainstream customers. In this respect, there is a risk that development over-serves their demands. This over-development of products leaves less demanding customers unsatisfied and makes them search for alternatives. This opens the door for new players with new products that may have disruptive potential (Christensen, 1997).
For a common understanding the characteristics of DI can be defined as follows (Christensen, 1997; Christensen and Raynor, 2003; Govindarajan and Kopalle, 2006; Nagy et al., 2016; Hang et al., 2011):

- The DI underperforms with regard to the attributes valued by mainstream customers;
- New features offered by DI are not valued by mainstream customers at first;
- DI address new or so far unserved customers;
- DI are typically simpler and cheaper than existing products;
- DI are introduced to low-end and price-sensitive customer segments making them unattractive for established firms due to low margins;
- The performance of DI is improved over time they match what mainstream customers value;
- DI offer the potential of a long-term market impact;
- DI have a higher ease of customer learning compared to SI.

Regarding the management of DI, most existing literature focuses on delaying disruption (see Christensen et al., 2002; Hang et al., 2011) and identifying the disruptive potential of newly launched products (Christensen et al., 2002; Govindarajan and Kopalle, 2006; Nagy et al., 2016). These approaches tend to deal with disruption passively, and cannot reduce the risk of disruption for firms (Rasool et al., 2018). In contrast, this paper focuses on how to actively manage DI. For this, three factors can be derived from current research that are crucial for handling DI.
First, DI addresses non-customers whose needs are not served by existing product attributes. In his five-step framework Rasool et al. (2018) starts by making market observations to identify existing and future customers while also considering those not served by the firm to gain a holistic perspective. Also challenging is the identification of customer's needs. Here, methods like focus groups, lead user concepts, conjoint analysis and activity diagrams are stated to collect the voice of the customer that is later derived into detailed needs (Ye and Gershenson, 2008). The focus on customer needs is crucial for DI because there is no existing product to which customers can relate. Hence, DI are hard to imagine in advance based on the experiences with current products.
Second, it is crucial to predict the disruptive potential of innovations ex ante (Danneels, 2004). An ex post consideration is not purposeful, because established firms are often unable to provide a competitive product once disruption has started. Most existing ex ante approaches require feedback data from customers, which makes them less suitable for product development's early stages due to the lack of available data (Hang et al., 2011). Hang et al. (2011) present an approach with which the disruptive potential of product ideas can be determined ex ante via a checklist, using the characteristics of DI mentioned above. Here, positive answers indicate a higher possibility for an idea to be disruptive. Using ex post performance measures (e.g. market size, profitability) to make ex ante predictions may be inappropriate due to high uncertainty and unpredictability (Govindarajan and Kopalle, 2006).
Third, customer needs and trends can change over time, so that product performance may be valued differently. This is why disruption is not obvious until these technologies match customer needs. This leads firms to constantly monitor an idea's possibly disruptive potential (Christensen et al., 2015). Thus, disruption can be seen as a process that can be transferred to the development of DI.
In this respect, Christensen (2015) displays that DI require customized strategic approaches to minimize the risk of using the wrong methods and tools that can reduce the chances of success. The allocation of

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resources to DI is particularly difficult for firms that have institutionalized the innovation processes, which mainly focus on the further development of existing products (Christensen et al., 2015).
Summarizing, research asks for approaches that assist firms in developing product ideas that have disruptive potential (Rasool et al., 2018).

2.2. Value-orientation in innovation portfolio management

IPM's main decision is about pursuing the right, goal fulfilling projects (Cooper et al., 2001). Here, a holistic perspective on the portfolio is crucial to consider the interaction of the projects that build the parts of an interconnected and overlapping whole (Killen et al., 2006). The main objectives of IPM clearly show that it is strongly interrelated with the fields of requirements management, roadmapping and release management. In this context, Şahin et al. (2019) described that the adjacent field of release planning also needs a stronger focus on value orientation in the sense of value driven design.
IPM can be classified in the early phase of the innovation process, where product ideas are generated and evaluated that serve as a basis for the conceptualization of new products (Eversheim, 2003). IPM in particular can be divided into the four phases of defining the strategic objectives, prioritizing and selecting projects, planning the portfolio and its continuous management (Deutsche Norm, 2013). A main challenge in IPM is to objectively evaluate projects at a low level of available information and high uncertainty regarding project outcome and effect on the environment (Flechas Chaparro et al., 2019). This contribution focuses in particular on the evaluation of product ideas in the sense of IPM.
The majority of IPM approaches dealing with project evaluation are based on the findings of Cooper et al. (2001) who defined three major goals in IPM: *value maximization, balance and strategic fit*.
Value maximization is usually understood from a business' perspective and aims at profitability and probability of success. To evaluate business value, quantitative financial methods are omnipresent to measure revenue, sales, profitability etc. - e.g. by NPV (Cooper et al., 2001; Killen et al., 2008; Flechas Chaparro et al., 2019; Tolonen et al., 2015). These methods require high quality data that can be derived e.g. from comparable or past projects. Empirical studies have shown that financial methods are most commonly used in practice due to their practicability and comprehensibility because of their quantitative characteristic but do not foster a high performing portfolio (Cooper et al., 2001; Killen et al., 2008). In addition, the use of financial methods negatively influences the firm's ability to enter new product arenas and capability to develop innovations with high novelty and uncertainty (Killen et al., 2008).
Compared to business value, a customer's perspective for value is toughly covered in current literature (Cooper et al., 2001; Killen et al., 2008). Most approaches mention customer value as an influential factor but only a few support its assessment (Soban et al., 2012). When considered, the orientation on customer needs as a criterion for project evaluation is often carried out in a qualitative way (Cooper et al., 2001; Tolonen et al., 2015). Chao and Kavadias (2008) warned that qualitative statements whether the project meets customer needs can be manipulated easily to achieve the desired results. Some authors also mention that customer needs are subject to temporal change so that the portfolio decision has to be adjusted accordingly (Killen et al., 2006; Fitzgerald and Ross, 2012).
As the second goal, *balance* of projects refers to the innovation portfolio consisting of different project types, e.g. in terms of level of risk, innovativeness and time horizon (Cooper et al., 1999). Balancing has direct effects on the firm's ability to pursue innovations with different degrees of novelty (Chao and Kavadias, 2008). Methods for portfolio balancing are portfolio maps and bubble diagrams which serve more as information display than decision models (examples in Cooper et al., 2001; Mikkola, 2001). In terms of a balanced portfolio containing high value projects empirical studies confirm the positive effects of a continuous revision of the project's value contribution (McDonough and Spital, 2003). When composing the innovation portfolio the right number of projects is crucial to optimally exploit resources like development capacity (Cooper et al., 2001).
Strategic fit as the third goal can be achieved through several approaches that ensure the alignment of projects and resource allocation to the firm's strategy that has positive impact on portfolio performance (Killen et al., 2007). It enables businesses to enter new markets, brings new technologies into the business, ensures high value projects and spending reflecting long-term objectives (Killen et al., 2008). The approach by Chao and Kavadias (2008) introduces strategic buckets to divide the firm's resources to innovations with different types of uncertainty to prosecute them independently.

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To achieve these three main goals in IPM a variety of methods were developed (overview e.g. in Archer and Ghasemzadeh, 1999; Flechas Chaparro et al., 2019). Especially for innovations with high uncertainty qualitative models are common (e.g. scenario-based approaches). Quantitative methods are more suitable for handling risk rather than uncertainty in which the probabilities are unknowable (Brasil et al., 2018). Methods such as scoring / ranking models as well as checklists enable specific applicability through modifiable evaluation criteria (Cooper et al., 2001). When defining these criteria, Mathews (2011) recommends a uniform and comparable set of attributes to ensure an objective evaluation with quantitative and independent metrics that can be applicable at all stages of concept maturity.
Summarizing, current research provides extensive methods for evaluating different innovation types in IPM. Research does not provide a standardized evaluation approach valid for every innovation type due to the complexity and diversity of use cases. Here, research suggests to adapt IPM methods to specific use situations in firms to optimally exploit the opportunities (Killen et al., 2007; Brasil et al., 2018; Flechas Chaparro et al., 2019). This displays the need for adapted evaluation methods for different innovation types.

3. Requirements for managing DI in value-oriented IPM

The previous sections outlined about the current research, relevance and potentials of DIs and IPM. This section deals with the definition and discussion of requirements of how DI can be implemented in IPM, derived from the findings of previous sections. For this purpose, the requirements are divided into two categories: The appropriate identification of the disruptive potential of the product idea and the implications in IPM to cope with DI. The left column of Table 1 gives an overview of the requirements.

Table 1. Analysis of existing IPM approaches regarding value orientation

○ not mentioned or considered within the approach
◗ mentioned but not considered within the approach
◗ considered not according to requirements
◕ considered but partially according to requirements
● considered according to requirements

		Selected IPM Approaches							
		Mikkola (2001)	Charo and Kavadias (2008)	Kester et al. (2014)	Söllner (2016)	Flechas Chaparro *et al.* (2019)	Archer and Ghesamzadeh (1999)	Mathews (2011)	Tolonen *et al.* (2015)
Identifying Disruptive Potential	Considering customer and market demands	◕	◗	◗	◕	◗	◗	◗	◗
	Considering the fulfilment degree of customer demands	◗	○	◗	◗	◔	○	◗	◗
	Considering higher levels of customer value	◔	○	○	○	○	○	○	○
	Considering temporal variation in value proposition/perception	◗	◗	◗	◗	◗	◗	◗	◕
Evaluating Product Ideas	Considering innovation‘s contribution to economic success	◗	◕	◕	●	●	●	◕	◕
	Considering innovation‘s impact on environment	○	◔	○	◔	○	○	○	◔
	Comparable and measurable description of customer value	◗	◔	◔	◗	◗	◔	◗	◗
	Considering ambidexterity in IPM	◗	◕	○	◕	◗	◔	○	◗

3.1. Identifying the disruptive potential of product ideas

Christensen and Raynor (2003) state that *considering customer and market demands* are the basic condition for managing DI. Thus, firms are required to collect and understand detailed information about their customers, especially regarding the solution-neutral and function-oriented requirements for the product use (Christensen and Raynor, 2003; Schimpf, 2019).
SI address mainstream customers which makes their evaluation comparably easy because methods requiring customer feedback can be applied. DI offer a different set of features that is not perceived and therefore valued by mainstream customers, which makes it difficult to forecast their potential. Thus, the performance of perceived product attributes cannot be used for the comparison, because DI would be inferior in a direct facing with SI. On higher levels in Woodruff’s (1997) value hierarchy, innovations contribute to achieving goals and serving use situations. Here, the disruptive potential can become clear. So, the evaluation should be done considering customer goals satisfaction and the usefulness in desired and conceivable use situations. Thus, firms not only need to consider how product attributes are

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perceived, but also to understand the essence of customer demands. So, it can be derived that *considering higher levels of customer value* can be effective when managing both SI and DI.
A difference between SI and DI is their *fulfilment degree of customer demands*. DI concentrate on the basic demands of customers for achieving their goals in specific use situations (Schimpf, 2019). Furthermore, they offer a greater potential for improvement than SI. Therefore, DI address customer demands that are fulfilled partially, with a gap to their complete fulfilment. SI only have a small gap or may already be overserving customer's demands.
This fulfilment degree of customer demands and thus the value perception of customers is shaped over time by many different factors (Woodruff, 1997). This leads to the thesis that an innovation could not express its disruptive potential when launched at the wrong time – e.g. when it does not meet even the market's low end requirements or when customer learning is not yet advanced to recognize the new product as a problem solving alternative. Customer learning opens up the possibility of failure if customers are not ready for the new innovation because their goals and use situations are aligned to familiar products. So, the process of if, when and how customers perceive product attributes can temporarily vary. Thus, *considering temporal variation in customer demands and value proposition and perception* becomes a relevant aspect.

3.2. Evaluating product ideas in IPM

While DI is associated with a high risk, firms need to also concentrate on their most profitable products through SI. This provides the needed income to finance the development and launch of DI (Christensen et al., 2015). Thus, *the innovation's contribution to economic success* needs to be considered. This view is also necessary for a launched DI to expand its market share and profitability.
A major uncertainty in forecasting is the firm's awareness about its actual and potential customers but also the customers' awareness of products that help in achieving their goals. There is the risk that DI may fail if customers do not see an alternative solution. This problem does not exist for SI as the products to be improved are already in the customer's focus. Here, customer perception and the market presence of products are interdependent - e.g. customer learning can be influenced by purposeful marketing or the launch of new products. So, firms need to *consider the innovations' impact on their environment*.
In a direct comparison in the evaluation DI are inferior to SI due to their abstractness and uncertainty, e.g. regarding their outcome. SI can be described and evaluated with a higher informative safety by commonly used financial methods (Cooper et al., 2001; Killen et al., 2008). So, just because of their easier representability SI have advantages in IPM decisions. Thus, it is important for the evaluation in IPM to *describe both DI and SI at a comparable level*, e.g. by means of a consistent set of criteria that can be used with common methods to reduce abstraction.
Achieving balance in IPM, necessitates a simultaneous management of DI and SI. Because of their different characteristics, each innovation type requires adapted processes and methods that may be in contradiction to one other. The capability of firms to simultaneously explore products with high novelty (exploration) and be efficient in daily business (exploitation) can be understood as ambidexterity (Tushman and O'Reilly, 1996). This includes a process- and organization-oriented perspective to IPM that requires to *ensure ambidexterity in the portfolio process*.

4. Evaluation of selected IPM approaches

Since this contribution focuses on the potential identification of product ideas and their evaluation in IPM, approaches that introduce methods with a corresponding focus were considered in the literature analysis. Due to their synonymous use, approaches for R&D, NPD and project portfolio management are also included when focusing new product ideas, ideally already considering different innovation types and customer value. So, approaches with a generic perspective and those that focus only on already developed products were not part of this analysis. In order to provide a structured overview and avoid redundancies only most current versions of the approaches were considered. Essential was also their publication date after Christensen (1997) released the fundamental definition of disruption, to enable its possibility of consideration. The review resulted in eight approaches (Mikkola, 2001; Mathews, 2011; Chao and Kavadias, 2008; Flechas Chaparro et al., 2019; Archer and Ghasemzadeh, 1999; Söllner, 2016; Tolonen et al., 2015; Kester et al., 2014) that were analysed regarding their fulfilment of the defined requirements (section 3). For this purpose, a five point rating scale was defined that is shown with the evaluation results in Table 1.

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It was found that all approaches consider customer and market demands. The relevance of customer and market value is stated as an ultimate objective for project development. However, only few studies have explicitly taken into account to what extent customer demands are fulfilled by an innovation. It becomes apparent that these approaches consider customer value more as an excluding than as an evaluating factor - so, the focus is more on "if", not "how" the customer perceives value. The value maximization criteria provided by Tolonen et al. (2015) relate more to business value due to their financial focus. The authors consider customer value as a relevant evaluation criterion for portfolio value on a rather generic level without further specification. Mikkola (2001) considers customer value as benefits through perceived product attributes (e.g. pricing, quality). Here, customer value is understood as customer satisfaction that requires customer feedback, and is thus less applicable for DI (Kester et al., 2014). So, a clear assessment of the fulfilment degree of customer demands is not provided in the intended sense.

Current customer focus mainly relates to the level of product attributes, thus higher levels in customer value remain opaque. It is thus also unclear, to what extent an innovation contributes to the fulfilment of customer goals. So, the necessary value orientation to consider DI is not provided as intended.

To take into account the possibility of temporal changes, Mathews (2011) and Söllner (2016) a use scenario technique to map potential developments, Archer and Ghasemzadeh (1999) suggest frequent portfolio revision to track the maturity level of the projects. Chao and Kavadias (2008) consider the occurrence of disruptive trends in their approach and therefore emphasize the need to react flexibly to environmental changes. Söllner (2016) introduced a method to constantly keep track of environmental changes to reallocate resources within the portfolio. So, the relevance of considering environmental changes can be reflected in research. However, the intended sense – to systematically capture changes of customer demands to forecast the progress of a disruptive trend – cannot be noticed in research.

When evaluating innovations in IPM, Mathews (2011) and Archer and Ghasemzadeh (1999) not explicitly mention the importance of a comparable project description, but define levels at which information of a certain quality is available. As possible levels for comparison, Mathews (2011) recommends qualitative assessment in the early stages and quantitative assessment in advanced stages of the process due to increasing data quality. Customer value is mainly considered in a qualitative way to take its abstractness into account, e.g. by portfolio maps (Mikkola, 2001). In quantitative assessment it becomes immediately apparent that a business' perspective is dominant. Financial methods to determine business value are highly represented (Archer and Ghasemzadeh, 1999; Söllner, 2016; Chao and Kavadias, 2008; Kester et al., 2014). To cope with higher uncertainty probabilistic methods are presented (Flechas Chaparro et al., 2019). Due to their ease of use and less abstractness, quantitative methods are used more frequently - so, business value is in focus. This separation of customer and business value in terms of content and process confirms the need to bring both value dimensions together on a comparable level, e.g. by making customer value comparable and measurable.

Flechas Chaparro et al. (2019) indirectly ensure the comparability of different innovation types by assigning a variety of evaluation methods to incremental and radical innovation. Söllner (2016) uses a unified set of premises and valuation factors for different types of product concepts to ensure their comparability. Although a comparable description between different innovation types is not openly addressed, its relevance in innovation management can be confirmed. Due to the missing consideration of DI in IPM a comparable description with SI is not clearly evident.

In order to manage projects with divergent characteristics, Chao and Kavadias (2008) introduce the concept of strategic buckets, where projects are being pursued in separate business units in order to ensure the specific use of processes and tools (structural ambidexterity). In this context, Flechas Chaparro et al. (2019) offers an adaptable framework to consider incremental and radical innovation by classifying suitable evaluation methods. Söllner (2016) ensures the management of different innovation types through a unified set of premises, but explicitly excludes applicability to DI. Therefore, it can be stated that research provides approaches to manage divergent innovation types, focusing SI – whether the methods are applicable to DI is to be examined.

As a result of the analysis, the stressed need for value orientation to evaluate and follow up DI in IPM is clearly evident. Current approaches tend to evaluate ideas from a business' perspective where there is little transparency about customer value perception. So, these approaches are designed for SI but do

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not cope with multidimensional problems of DI. It is important to point out, that the analysis of customer and market data is not a main objective in IPM. Though, the access to this data and its utilization should be of special interest and part of IPM decisions. So, a comprehensive implementation of customer value orientation in IPM under consideration of the defined requirements needs to be conducted.

5. Framework for managing DI by value-oriented IPM

Based on the presented IPM approaches, Woodruff's (1997) concept of customer value and the defined requirements from section 3, a framework was developed to address the identified research needs. It highlights elements of and interdependencies between IPM, DI and value orientation (Figure 2).

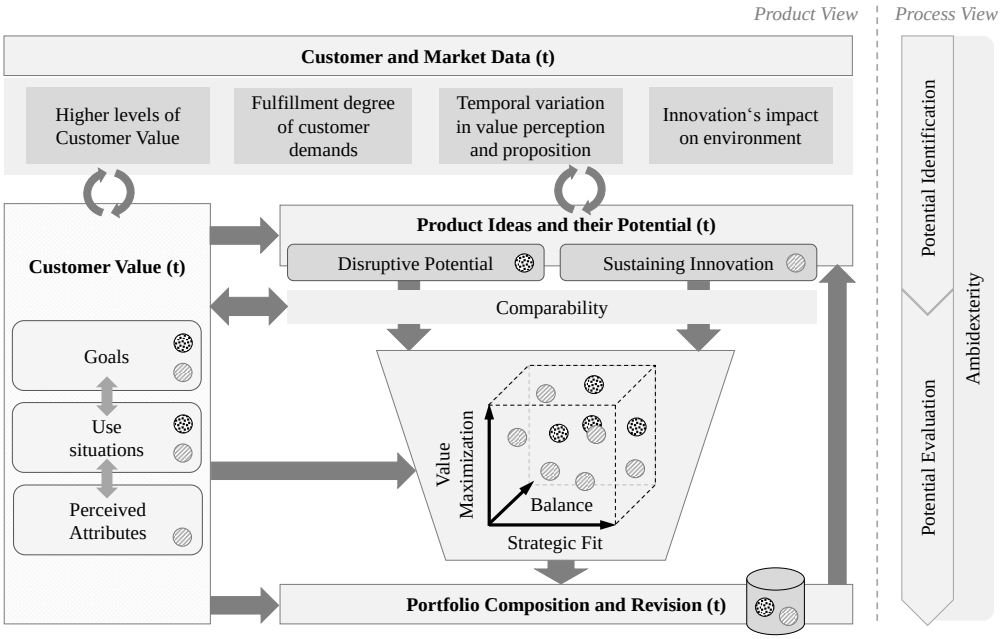

Figure 2. Framework for managing DI in value-oriented IPM

The framework refers to the early phase of the innovation process, including the identification and evaluation of innovation potential, the selection of the most promising projects and the management of the innovation portfolio (Eversheim, 2003). The concept of customer value is closely linked to the elements along this process, serves as an indicator for the potential of innovations and should be modelled for the specific application due to the variety of use cases, like most IPM approaches.
Customer and market demands serve as an origin for product ideas. The idea's (disruptive) potential can be determined based on the defined requirements (sec. 3). Customer data can also be transferred into customer value which is considered on three levels, whereas the higher levels being applicable to DI. Also important for DI is the inclusion of time dependencies (t), which are expressed here by measurable descriptions and also include their anticipation, e.g. based on customer learning and changing value proposition. Once modelled, customer value can enable simultaneous valuation of DI and SI, serve as an evaluation criterion and be implemented in existing IPM approaches. In project evaluation, the three main goals of IPM – value maximization, balance, strategic fit (Cooper et al., 2001) – form the three measurement dimensions, supported by various evaluation methods (overview in Flechas Chaparro et al., 2019). In this confined space, interactions between the projects can and should be taken into account in order to meet the holistic idea of IPM. The inclusion of customer value in the composition and revision of the portfolio allows it to be adapted to environmental changes (e.g. product optimization in terms of value proposition and perception). To ensure holism, not only new but also existing projects whose disruptive potential may have changes should be included in the iterative review process. From a process perspective, ambidexterity should be focused to ensure both exploration via DI and exploitation via SI.

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Because the framework is derived from theory, further research is needed to operationalize it. Existing processes and methods in IPM can serve as a basis for this but need to be extended in terms of value orientation especially from a customer's perspective. Since business value aspects and SI with different levels of uncertainty are already considered comprehensively, further research is needed focusing their implementation in the proposed framework. The description of customer value needs to be focused in further research to serve as a rating factor to evaluate disruptive potential, compare DI and SI and include temporal changes in value perception based on its interaction with environmental dimensions.

6. Conclusion and outlook

Firms can use complex and volatile environments that promote disruptive trends to develop DI themselves. The challenge for firms is not only to identify such disruptive potential but also to properly allocate resources to DI for their development. For this, both DI and SI need to be considered equally in the assessment in IPM. Therefore, existing approaches to identify disruptive potential and evaluation methods in IPM were presented. On this basis, specific requirements for also considering DI in IPM were derived, with which the literature was analysed. It was found that value orientation in IPM is mainly carried out by results-oriented business value and customer value in the sense of perceptible product attributes. This leads to opaque value orientation on higher levels of customer value that is found to be important to take DI into account. Based on the findings, a framework was presented that highlights aspects and relations regarding a value-oriented IPM for DI. The framework is derived from theory and therefore can serve as a reference for the design of operatively applicable methods, which however needs to be validated. Further limitations that impede the practical application of the framework can be considered as a basis for further research, that is particularly necessary in the fields of describing customer value on a level, on which disruptive potential can be clarified and DI and SI can be compared (e.g. in terms of goal achievement and desired and conceivable use situations), providing additional ways to evaluate customer value to make future values and their volatility comprehensibly measurable and operationalizing and testing them in existing IPM processes and methods.

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