NECESSARY EXTENSION OF CONVENTIONAL IDEA PROCESSES BY MEANS OF A METHOD FOR THE IDENTIFICATION OF RADICAL PRODUCT IDEAS

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Abstract

The high failure rate of trials for implementing radical innovations underlines a demand for supporting the development process for new radical innovations. This demand has arisen in many companies over the last few years and has also been recognized in expert interviews with industrial partners of our institute in the last few months. Our institute's research project "Handling radical innovation in the field of idea processes and product development" addresses that topic and researches methodical support to meet the described need. This paper will demonstrate the necessity of adding conventional idea processes by means of a method for the identification of radical product ideas. Furthermore, there will be discussion as to how such a method can be elaborated and what should be taken into account according to the characteristics of radical product ideas or innovations. The step of identifying radical product ideas in idea processes in order to separate them and treat them differently from incremental product ideas is seen as imperative. Additionally, the paper considers the question of how such an identification step for radical product ideas can be elaborated in future research.

Keywords: Innovation, Idea management, Radical innovation, Early design phases, Design process

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1 INTRODUCTION

In the age of saturated markets and targeting the highest enhancements in efficiency, innovations offer one possibility for economic growth (Gassmann and Granig, 2013; Meyer, 2012; Vahs and Burmester, 2005). Although many companies have launched new innovations onto the market very consistently in the past few years (Freytag, 2016), the innovation performance has not reached a level of high satisfaction because the majority of innovations only constitute an improved variant of existing products (McDermott, 1999; Meyer, 2012). There is a lack of "really new products" (Meyer, 2012) that open up new prospects and new markets – so-called "radical innovations" (Meyer, 2012). These are regarded as particularly innovative products and are seen as essential for long-term corporate success (Chandy and Tellis, 2000; McDermott and O'Connor, 2002).

Nowadays, radical innovations are very frequently discussed and required because companies do not want to face the fate Nokia, Kodak or Blackberry had to suffer by missing the change to a new radical innovation (Meyer, 2012). In that context, Wang (2014) published a note of caution two years ago after having determined that 52% of all companies among the Fortune Global 500 in 2000 have either gone bankrupt, become part of another company or ceased to exist. In fact, in common practice, there is often only a reaction to the wishes of improvement based on market demands. Truly new innovations are hardly ever promoted (Meyer, 2012). Only ten percent of a company's innovation projects concern the development of a radical innovation (Hartschen et al., 2009), although they are assessed as profitable projects if successful. Companies experience difficulties with the realization of radical innovations (Dueck, 2013; O'Connor and Rice, 2013). One problem is that conventional approaches for implementing innovations applied to radical innovation projects are rarely successful (Gemünden and Kock, 2010), meaning different approaches are required (Veryzer, 1998). The high failure rate of trials for implementing radical innovations (Stevens and Burley, 2003; Zimmermann et al., 2001) underlines a demand for supporting the development process for radical innovations.

This demand has arisen in many companies (Leifer et al., 2000; Meyer, 2011) over the last few years and has also been increasingly recognized in expert interviews with industrial partners of our institute in the last few months (refer also to Herrmann et al., 2016). Our institute's research project "Handling radical innovation in the field of idea processes and product development" addresses that topic and researches methodical support to meet the described need.

2 PROBLEM STATEMENT, RESEARCH CONTENT AND GOAL

To focus the research activities presented in this paper, the main topic of the present paper is handling radical product ideas in the early stage of product development – called the "front-end phase" (Koen et al., 2002). Radical product ideas should be understood as ideas that seem to result in a radical innovation. A radical product idea is therefore seen as a preliminary stage of a successful implementation of a radical innovation.

In this context, in order to ensure consistent interpretation, the term "product" may describe a product which is tangible, i.e. material (e.g. hardware, processed materials), a product which is intangible, i.e. immaterial (e.g. software, services), or a combination of both (DIN EN ISO 9000, 2009). Among many definitions in the pertinent literature (inter alia DIN CEN/TS 16555 Part 1, 2013; Eisert, 2006; Herstatt, 2007; Leifer et al., 2000; Stilianidis, 2015; Tatarczyk, 2009; Wind et al., 2002), a radical innovation should be defined, according to Scigliano (2003), as a change to the existing service offer which is based on a new technology or a new product architecture for the purposes of this paper. The innovation causes a change on the market by developing new product categories or by changing branch-specific rules (Scigliano, 2003).

The relevant literature often proposes idea processes for dealing with product ideas in the front-end phase (inter alia Messerle et al., 2013). However, conventional idea processes practiced in many companies should be examined critically in terms of whether they are responsible for the tendency that innovations nowadays often only constitute incremental innovations. Messerle et al. (2013) claim that ideas for radical innovations are often rejected in early evaluation processes because radical product ideas do not seem to be controllable at first glance. Some industrial experts of our institute's research partners also demanded that radical product ideas require a special process and cannot be compared to incremental ideas or evaluated with the same criteria.

So, as mentioned before, conventional idea processes often proposed in literature do not completely satisfy idea process steps of radical product ideas and should be adjusted or even extended. The goal of this paper is thus to demonstrate requirements of expansion and adaption of such an idea process. Additionally, how this adaption or expansion will be analyzed is demonstrated based on initial investigative approaches.
In order to be able to meet the specific requirements of an idea process focused on radical product ideas, it is necessary to extend the existing basic framework of an idea process in such a way that – in an ideal scenario – all necessary process steps and aspects of an idea process take the characters and properties of radical product ideas into account.
Investigation and elaboration approaches for the outlined adaption of an idea process for radical product ideas are presented. All of this forms part of the aforementioned research project (see Section 1) with the overarching goal of developing an idea process for radical product ideas which can be used as a generic basis for a simple and appropriate adaptation in different companies.

3 METHOD AND STRUCTURE

As a structural measure, the research paper presented is based on the Design Research Methodology (DRM) according to Blessing and Chakrabarti (2009). Its general content is based on four steps (Blessing and Chakrabarti, 2009), of which three steps are addressed within this paper.
In the first step of the DRM – the "Research Clarification" – the research aims are elucidated (see Sections 1 and 2). To develop a wider background for the problem and to obtain a better understanding, results of literature screening regarding the state of the art are presented in the "Descriptive Study I" (see Section 4). For this purpose, literature sources dealing with conventional idea processes (see Section 4.1) and special recommendations for the design of idea processes for radical product ideas (see Section 4.2) have been screened and important excerpts will be presented. In the third step of DRM, the "Prescriptive Study", approaches are developed for improving the current situation. Here, the research need is clarified and presented in detail. Furthermore, the procedure pursued within this paper and the overarching research project is initially outlined in Section 5. Initial approaches concerning the development of an identification step for radical product ideas within an idea process will also be presented in Section 6. This will take the form of an analysis of the characteristics of radical innovations as well as the derivation of consideration dimensions for identifying radical product ideas. Further tasks and issues to be addressed in future research work are presented and discussed in Section 7. In particular, this mainly includes the full elaboration of an identification tool for radical product ideas and the elaboration of further steps or the adaption of steps comprising an idea process. The last step of the DRM is called "Descriptive Study II". Here, the developed support or results are evaluated in order to comply with scientific requirements. This evaluation does not form part of this paper and has to follow in the next research steps, as mentioned in Section 7 and the outlook (Section 9). The results will be critically discussed in Section 8.
To summarize the procedure, Figure 1 shows the elaboration of an idea process for radical product ideas.

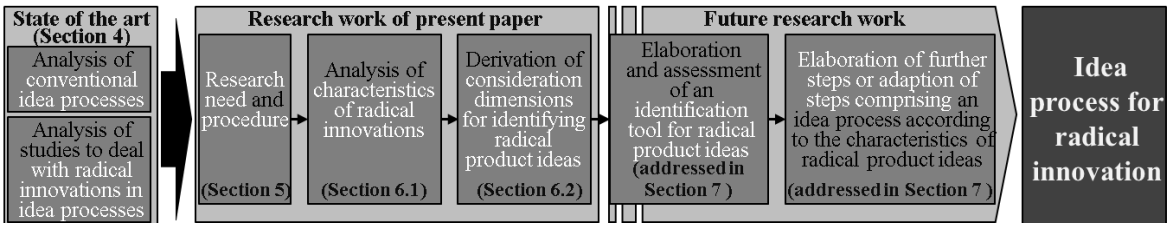

Figure 1: Elaboration of an idea process for radical product ideas

4 STATE OF THE ART

For the analysis of the pertinent literature, two main aspects have been examined: How do conventional idea processes look and what are the main steps and aspects concerned in such idea processes (Section 4.1)? Which studies deal with recommendations for idea processes for radical product ideas and what are the main differences to conventional idea processes (Section 4.2)?

4.1 Conventional idea processes

Before analyzing different approaches for idea processes in a comprehensible way, a significant definition for an idea process is required in order to define the focus of this paper. The idea process is seen as a process starting with the creation of product ideas and ending with the selection of one of these ideas ready to start with other steps of the product development process through to the realization of new products. This process is part of the planning step of the product development process (Verein Deutscher Ingenieure 2220, 1980) and is implemented before a detailed design specification is developed.

A multitude of sources can be found in pertinent literature which propose systematic procedures starting from the initial step of idea creation and ending with realization (Brandenburg, 2002; Cooper, 2011; Geschka, 2005; Kerka, 2011; Kühn, 2003; Stevanović et al., 2012; Vahs and Brem, 2015; Verein Deutscher Ingenieure 2220, 1980; Wahren, 2004).

Most of these approaches have a significant number of similarities. Partial synonymous terms are used for the individual process steps in various literature sources. All proposals for idea processes take one to three evaluation steps into account that follow the step of creating new product ideas. Irrespective of how many evaluation steps are recommended, an evaluation step is always a sort of a milestone where a decision is made as to whether the ideas can pass the milestone or have to be rejected or stored in an idea storage pool, which is often part of the idea process (Cooper, 2011; Geschka, 2005; Wahren, 2004). At the end of an idea process, the selection of ideas ready for realization according to the last evaluation step should be performed. With more than one evaluation step, an increase in the degree of detail of the idea description and the evaluation criteria is recommended with every evaluation step (Cooper, 2011; Kerka, 2011; Vahs and Brem, 2015; Wahren, 2004).

To present one graphic example, the approach of Messerle et al. (2013) is illustrated in Figure 2. This demonstrates a general idea process presenting the most important steps or contents of an idea process including the steps of idea creation, idea capture, idea detailing, idea evaluation (here: three evaluation steps = rough, precise and detailed evaluation step), idea selection and the use of an idea pool, which should be regularly reviewed within the step of idea creation.

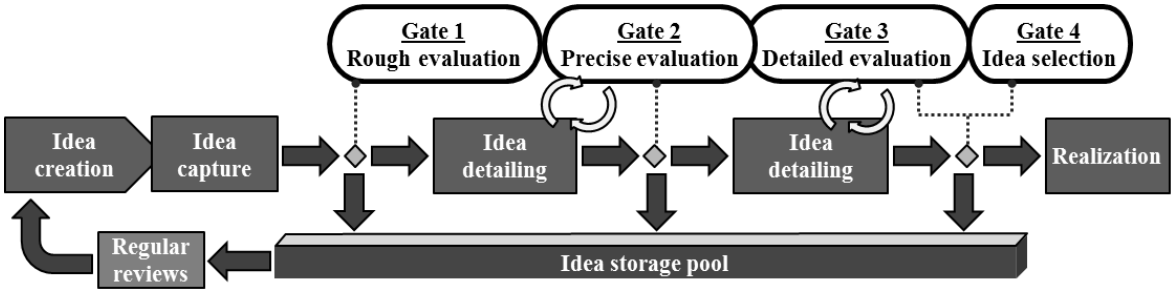

Figure 2. General idea process (based on Messerle et al., 2013)

4.2 Analysis of studies dealing with radical innovations in idea processes

After having analyzed different approaches for idea processes (Section 4.1), the present section will analyze literature approaches dealing with idea processes for radical product ideas and the different ways of handling radical product ideas in an idea process in particular.

In actual fact, general idea processes for radical product ideas exist in the pertinent literature (compare inter alia Frishammar et al., 2016). However, they do not differ from general idea processes presented in Section 4.1 in their general structure and their main steps. There is actually no continuous process starting from the creation of radical product ideas and ending with the realization of an innovation which differs significantly from conventional idea processes. Nevertheless, there are some general recommendations on how to handle radical product ideas within a general idea process, aspects to be considered for radical product ideas and methods to be used for radical product ideas during the steps of the idea processes.

Concrete methodical advice exists for the step of idea creation, for example the recommendation of using TRIZ by (inter alia Geschka 2006) for developing radical product ideas.

Some sources in the relevant literature suggest particularly special treatment during the evaluation steps of radical product ideas within the idea process. Messerle (2016), for example, provides some general recommendations about how to identify ideas with high potential to become a radical innovation during

evaluation steps according to the evaluation criteria he developed. Kerka (2011) advises not using the criterion "fit to company's innovation strategy" because this is often a KO criteria for radical product ideas. These ideas often require a fundamentally new innovation strategy. This is underlined by Dueck (2013). Additionally, Kerka (2011) warns against using minimum return as an evaluation criteria for radical product ideas during a very early evaluation step.
In actual fact, there are warnings from researchers (inter alia Hartschen et al., 2009) not to use the same criteria for both incremental and radical product ideas. Incremental ideas often focus on risk and market chance. These criteria are difficult to assess for radical product ideas. Market and technological facts are insufficient to use for radical product ideas and are often considered vague and speculative. These ideas might thus fail to reach the next milestone in an idea process very early on. Therefore, proposals exist to separate radical product ideas from routine ideas and improving ideas (incremental ideas) before or during the first evaluation steps (inter alia Hartschen et al., 2009). The procedure for such a separation step is actually only described roughly in the pertinent literature or is based on a general recommendation (inter alia Hartschen et al., 2009; Messerle, 2016; Messerle et al., 2015).

5 RESEARCH NEED AND PROCEDURE

As outlined in Section 4, none of the cited approaches for idea processes are entirely satisfactory for handling radical product ideas. There is no approach for an idea process combining the handling of incremental and radical product ideas in one idea process.
Due to the fact that hardly any studies exist that propose detailed process models dealing with that task, the need for an idea process latently intimated in Sections 1 and 2 can be underlined.
To emphasize the demand for an idea process which can deal with both aforementioned types of product idea, two short case studies should be considered. Firstly, imagine a special idea process for radical ideas exists (consisting of idea creation, evaluation, detailing and selection steps; see Figure 3). Even if only methods for idea creation which address the creation of radical product ideas are used, it is very likely that incremental ideas will also emerge alongside radical product ideas. One step separating incremental and radical product ideas must therefore take place. After having separated all radical product ideas, the ideas must be evaluated using criteria which need to be adapted to the characteristics of radical innovations, or rather radical product ideas.
The second case study addresses the state of the art and the more frequent case that companies apply an idea process mostly designed for handling incremental product ideas (methods for idea creation, evaluation criteria etc.), as can be observed in industrial practice. If the company's goal is therefore to develop a radical innovation, product ideas for such an innovation are frequently rejected in evaluation steps (see Section 4.2). Radical product ideas thus have to be identified after the step of creating new ideas so as to be treated differently in the evaluation steps. This claim is also made by our industrial partners working together in the research project "Handling radical innovation in the field of idea processes and product development".
The step of separating radical product ideas from incremental product ideas is actually not considered in the pertinent literature. Furthermore, different evaluation criteria for radical product ideas and incremental product ideas are hardly used (compare with Section 4.2).

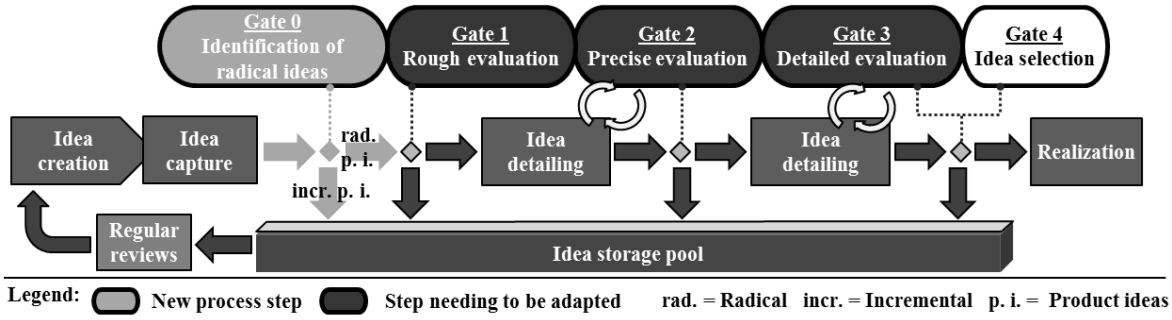

Figure 3: Idea process (according to Messerle et al., 2013) with suggested additional step to identify radical product ideas (see Gate 0)

To summarize the content of the aforementioned case studies, an identification step for radical product ideas is needed in idea processes in order to recognize radical ideas and to develop radical innovations

more frequently. This step is considered to be most ideally introduced after the step of creating ideas (see Figure 3, Gate 0) to provide a separation of radical and incremental product ideas as soon as possible – and before the subsequent detailing and evaluation steps.
Furthermore, existing evaluation criteria have to be reconsidered in terms of whether they can be used for radical product ideas. The latter does not form part of this paper and should be part of future work.
After having demonstrated the necessity for an identification step for radical product ideas, the question arises as to how this step can be implemented. The goal has to be that designers are able to differentiate between incremental and radical products as early as possible.
In order to develop a method for this, the following procedure has been applied. First of all, some instruments in literature dealing with the "measurement" of radical product ideas or the distinction of radical and incremental product ideas were analyzed. After realizing that these tools cannot be applied usefully in the companies in practice, a procedure for developing a new tool has been developed. For this, a list of characteristics of radical product ideas – or rather innovations to distinguish from incremental product ideas or innovation – is researched and developed. On this basis, important characteristics describing a radical product idea have been clustered according to different dimensions. This is done because characteristics of radical product ideas have to be viewed from a different perspective (e.g. market perspective, companies' perspective; see Section 2). These dimensions and their elaboration are presented within this paper. Future steps include the necessity of logic measurement and scales and thresholds in order to enable a meaningful statement to be made on whether a product idea is in fact a radical product idea. Requirements for the identification tool are simplicity and consistency, so as to help designers be more efficient during the handling of radical product ideas in idea processes. The method should help to shape the process more transparently and precisely and handle the increased risk of radical product ideas. A quick decision as to whether the present product idea is a radical product idea should therefore be possible.

6 IDENTIFICATION OF RADICAL PRODUCT IDEAS

In order to develop a tool for identifying radical product ideas, some results of literature research on that topic will be presented briefly. Green et al. (1995), for example, developed a tool which is based on 17 questioning items. These items were reduced to four factors describing radicalness: technology uncertainty, technical inexperience, technology costs and business inexperience. These factors were presented to indicate radicalness (Green et al., 1995), although a concrete measurement tool – or rather a procedure using these factors – has not been shown.
Schlaak (1999) used 35 empirical studies and a questionnaire of 123 companies to develop a procedure for measuring the degree of innovation. This means giving a statement as to whether an innovation is radical or not. He used 24 questioning items to derive seven factors in order to measure the degree of innovation for his procedure: product technology, sales market, procurement area, production process, formal organization, informal organization, capital requirement (Schlaak, 1999). Additionally, Schlaak used a seven-level scale to measure the factors and alleged that an average of more than 5.5 indicates a radical innovation, whereas an average of less than 2.5 indicates an incremental innovation (Schlaak, 1999). Although Schlaak (1999) provided a method to measure radicalness in a quantitative way, his procedure cannot easily be adopted for radical product ideas because no approach is given there for how to use his procedure in the early phase of idea processes, where a great deal of information about a possible product is unknown. As an example, the production process and the fixed capital requirement can only be roughly estimated in the early idea processes.
Research by Billing (2003) and Salomo (2003) was based on these considerations by Schlaak (1999). Both differentiate between a macro-perspective (new for the market) and a micro-perspective (new for the company) and also consider the social and political environment addressed by the innovation. Billing (2003) differentiates between the dimensions of technology, market, environment and organization. These have to fulfil a maximum level of change to indicate a radical innovation. There are far more researchers dealing with models for how to measure radicalness (inter alia Eversheim, 2003; Rice et al., 2001) and indeed there are a great many researchers conducting research into the degree of innovation, which is related to the measurement of radicalness (Binz and Reichle, 2007; inter alia Danneels and Kleinschmidt, 2001; Garcia and Calantone, 2002; Green et al., 1995). As it is, no model satisfies the need for measuring radicalness at the beginning of idea processes in order to differentiate between radical and incremental product ideas in a way which is applicable.

6.1 Characteristics of radical product ideas

In order to develop a tool to differentiate a radical product idea from other product ideas, the pertinent literature was screened for typical characteristics of radical innovations or radical product ideas. The objective was to analyze what is typical for a radical product idea or a radical innovation. Table 1 shows an excerpt of typical characteristics of radical product ideas or radical innovations found in the pertinent literature. The list makes no claim to completeness and far more characteristics and references can be found in addition to these. It should only provide an overview of the differences and the differentiation of radical innovations from routine product development projects (incremental innovation). The first column shows what is claimed in the specific reference listed in the second column in keywords. The content of the third column will be described in Section 6.2.

Table 1. Characteristics of radical product ideas or innovations derived from literature

Characteristic of radical product ideas or innovations	**Reference**	
Offer central success factors; permanent competitive advantage	Belz et al., 2007	A
Endanger market position of companies still focusing on the old technology	Cohen, 1995; Schumpeter, 1942	A
No use of routine instruments for market research possible; require new skills, levels of market understanding	Hartschen et al., 2009; McDermott and O'Connor, 2002	A
Long-term change of markets; create new market growth	Meyer, 2012	A
Higher risk than with incremental innovations, but chance for monopoly position, science and expertise lead possible	Vahs and Brem, 2015	A
Often require long-term development time (ten years or longer) and high investments; encounter a very different set of challenges than those typically faced by product development teams engaged in incremental innovation	McDermott and O'Connor, 2002; Leifer et al., 2000	B
Show a higher information deficit than a routine innovation does	Hartschen et al., 2009	B
Up to the concept phase, a lot of assumption and simple consideration as well as prototypes and simulations are necessary	Hartschen et al., 2009	B
Usually based on a technology push; new technology is implemented	Disselkamp, 2005; Acs and Audretsch, 1991	B
Often new experts or new knowledge sources necessary	Hartschen et al., 2009	B
Offer a superior benefit through targeted and customer-oriented use of new technologies	Belz et al., 2007	C
Offer a performance which cannot be found in the market so far; new user experience; even offers "New to the World" innovations	Acs and Audretsch, 1991; Belz et al., 2007	C
A long and hard way to go between idea and (potential business) opportunity	Leifer et al., 2000	C
Deep organizational changes are necessary	Motte et al., 2011	D
Critical to the long-term company success; necessary support from the upper management is often missing, especially in bigger companies	McDermott and O'Connor, 2002;	D
Unique task for management and organization; no detailed planning and control processes possible	Billing, 2003	D
Hit the entire company's organization with all important functional areas	Gatignon et al., 2002	D
Much more time, cost resources and manpower has to be considered than with incremental innovations	Hauschildt and Salomo, 2011	D
Need to re-consider existing structures and traditional environmental specifications	Hartschen et al., 2009	D
Potential for fivefold to tenfold improvements in performance or at least a 30 percent reduction in costs	Leifer et al., 2000	C, B
Market uncertainties Technological uncertainties Resource uncertainties; organizational uncertainties	Leifer et al., 2000	A, B, D
High level of creativity necessary; creative freedom is necessary for this	Billing, 2003	B, D

6.2 Derived consideration dimensions for radicalness

The goal of analyzing the characteristics of radical product ideas or innovations was first to learn more about that type of innovation and to derive a procedure for measuring radicalness. What can also be learned from the short excerpt from the characteristics analysis (see Table 1) is, that several dimensions are addressed with the individual characteristics. After having analyzed all the characteristics of our research, four main dimensions could be used in order to represent all important characteristics. These four dimensions address a "Market change" (A), the "Team of product developers" (B), the "Users of innovation", the "Product perception" (C) and the "Companies' organization" (D). All characteristics (compare with Table 1) always deal with a chance or influence of one of the mentioned dimensions. The last column of Table 1 symbolizes which dimension is assigned. The four dimensions also show that

radical product ideas in particular must be considered from different perspectives. This is underlined by Meyer (2012), who claimed that an innovation can be radical at a very low level but may be considered as very radical by the customer. After having developed the four dimensions mentioned above, we asked two experts from the same company – with which we have a close collaborative relationship in this research topic – for their assessment of the dimensions. Both underlined the importance, completeness and applicability of the four dimensions.

7 FUTURE RESEARCH WORK

The goal of developing the four consideration dimensions was to accommodate the different ways in which a radical product idea or innovation might be considered "radical". It is actually necessary to check these dimensions in detail in future research work in terms of their completeness, applicability and significance. Experts therefore have to be interviewed and asked for their assessments. The long-term goal of the research project is to develop a tool which indicates the radicalness of a product solution idea. As Figure 4 shows, a measurement logic should be elaborated for every developed dimension in order to assess the radicalness of the product solution idea of each dimension separately. For this purpose, criteria must be researched and scales must be devised for giving a statement on the radicalness of the solution idea in each dimension (compare Figure 4, right-hand side). The indicator "Radical" should summarize all results of the considered dimensions and should announce the radicalness of the product solution idea.

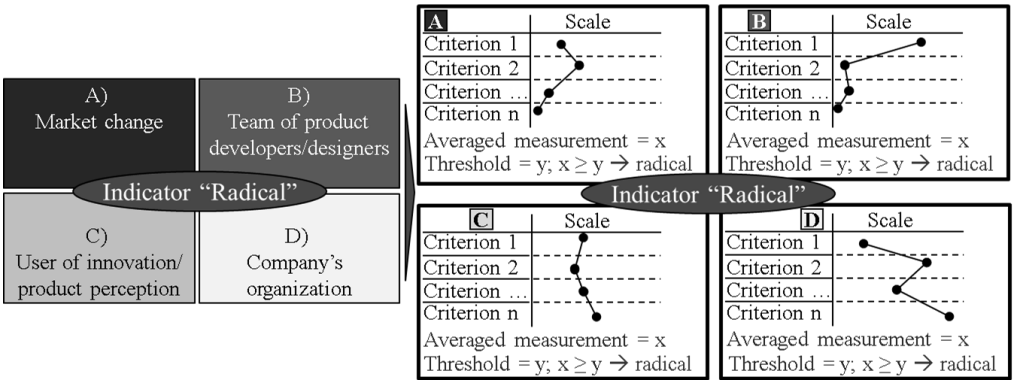

Figure 4. Procedure for the development of the indicator "Radical"

8 DISCUSSION

The results gained will be critically discussed in this section. The necessity of introducing a further step for identifying radical product ideas has been justified in detail within this paper. Furthermore, some assessments from experts were also considered. As this introduction forms part of the results of the overarching research project, the results of this paper can only be assessed properly by evaluating the whole process with an idea process for radical ideas in the future after the completion of the research work on that topic. The consideration of how to develop an identification tool for radical product ideas has to be discussed critically and developed with the support of practical expert input to consider its applicability. To summarize the discussion, the initial studies in this paper can be used to expand the research work in order to elaborate an entire support method for designers when developing radical innovations.

9 CONCLUSION AND OUTLOOK

In this paper, the necessity of adding conventional idea processes in the form of a method for identifying radical product ideas has been demonstrated. Furthermore, discussion was provided for how such a method can be elaborated and what aspects should be taken into account according to the characteristics of radical product ideas or innovations.

Based on the results and their discussion, certain conclusions can be drawn. The step of identifying radical product ideas in idea processes for separating them and treating them differently from incremental product ideas is not seen as imperative or is not discussed significantly in literature at all. However, it has been demonstrated in this paper that such a step is fundamentally necessary.

This paper is used to present the current status of this research topic. In particular, a procedure how the actual status can be evaluated, improved and what is necessary to reach an improved status should be presented. The procedure is based on research work which is carried out right now. The main aspects are presented in Section 7, where the approach for developing the indicator "Radical" is presented. After having developed criteria, scales and thresholds, the method must be developed in order to perform as a practical, transparent and applicable tool for differentiating radical product ideas from incremental product ideas. The whole tool must be assessed in business practice and implemented in a generic idea process. All interfaces and process steps must be adaptable to the boundary conditions and goals of the varying characters of companies.

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