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Portfolio Management for Innovation Ideas: Weigthing Antecedents with AHP

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ABSTRACT

Purpose: The purpose of this paper is to determine whether there are antecedents of innovation, which can be looked at during idea evaluations at the fuzzy front end.
Methodology: A systematic literature review was conducted for the antecedents of the innovation output, which were then verified and weighed by an integrated team of experts and academicians participating TIM's InoSuit project by using AHP.
Findings: The antecedents were isolated as value, applicability, contribution to innovation, generalization, strategy, risk, and suitability of existing solution, and their weights were determined as 12, 15, 10, 18, 8, 32, and 5 % respectfully.
Practical Implications: This research provides an analytical assessment model for the initial idea selection for innovation, which can be used within innovation management systems.
Originality: There is no comparable scale applicable to the selection in the very early phases of ideation.

Keywords: Innovation Portfolio, Analytic Hierarchy Process (AHP), New Product Development (NPD)
JEL Codes: M11, O32

İnovasyon Fikirleri için Portföy Yönetimi: Öncüllerin AHP ile Ağırlıklandırılması

ÖZ

Amaç: Çalışmada başlangıç aşamasında fikirlerin değerlendirilmesi için inovasyonun öncülleri araştırılmış ve ağırlıkları belirlenmiştir.
Yöntem: İnovasyon çıktısının öncülleri sistematik literatür taraması ile derlenmiş, daha sonra bu başlıklar TİM InoSuit projesinin katılımcılılarından seçilmiş uzman ve akademisyenlerden oluşan karma bir ekip tarafından doğrulanarak ağırlıkları analitik hiyerarşik süreç ile belirlenmiştir.
Bulgular: Öncüller, değer, uygulanabilirlik, inovasyona katkı, genelleme, strateji, risk ve var olan çözümün uygunluğu olarak derlenmiş, ağırlıkları da sırasıyla % 12, 15, 10, 18, 8, 32 ve 5 olarak belirlenmiştir.
Sonuç ve Öneriler: Bu çalışmada inovasyon yönetim sistemlerinde kullanılabilecek, ön safhalarda inovasyon fikirlerinin seçimine imkân sunan analitik bir değerlendirme modeli sunulmuştur.
Özgün Değer: Literatürde fikir oluşturmanın ön safhaları için karşılaştırılabilir benzerlikte başka bir ölçek bulunamamıştır.

Anahtar Kelimeler: İnovasyon Portföyü, Analitik Hiyerarşik Süreç (AHP), Yeni Ürün Geliştirme (YÜG)
JEL Sınıflandırması: M11, O32

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1. Introduction

To remain competitive, companies continuously need to upgrade themselves (Humphrey and Schmitz, 2002). This drives the change, which is strongly bounded to innovation (Iyer et al. 2006). In short, innovation is the added value generation (Jacobides et al., 2006) by new ideas, methods, or devices (Innovation, 2017). It can be in the form of subject innovation for business processes or object innovation for new products/services (OECD, 2005). Under the bottom line it enables continuous growth in the market share (Bear, 2006; Andrew et al., 2010; Gronlund et al., 2010). Consequently, companies spend time and efforts for innovation. They also implement innovation management systems to achieve an enabling environment, where they can systematically continue their innovation efforts (Nagji and Tuff, 2012).

Innovation management is a process (see Figure 1) and it starts with the proactive development of suitable strategies supported by associated ideas within a portfolio, which can be converted to innovation projects trough research and development activities (CEN/TS, 2013). The ideas in the innovation portfolio are gathered from the organization itself within the innovation value chain (Hansen and Birkinshaw, 2007) by interaction, circulation and growth of explicit and tacit knowledge (Nonaka et al., 2000; Nonaka et al., 2008). The resulting innovation output can be in (i) offerings, (ii) processes, (iii) distribution or (iv) customers (Tsekouras et al., 2014). A systematic (Morris, 2011) and total innovation approach (Nagji and Tuff, 2012) shall be applied yielding in new product development (NPD), which requires continuous efforts for idea generation, screening and selection (Deppe et al., 2002; Stamm, 2003).

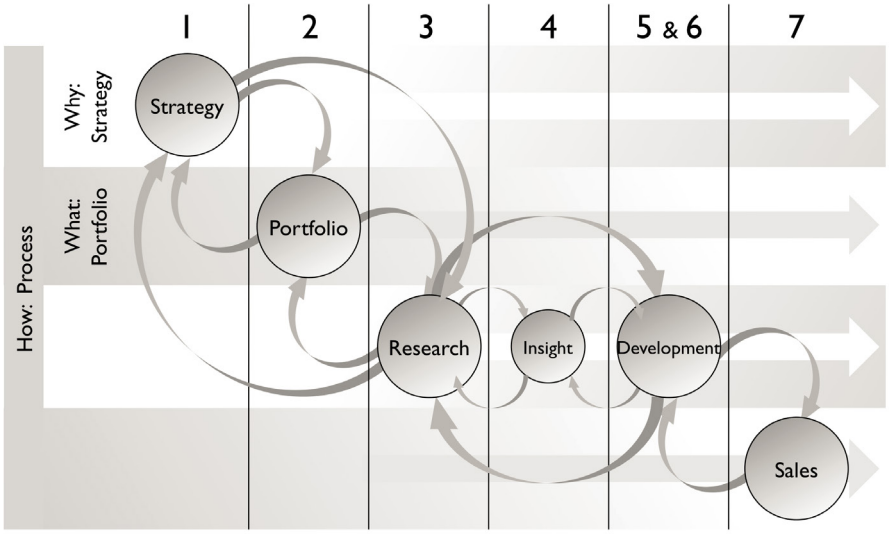

Figure 1. The process of innovation (Morris, 2011:167)

Initially, idea selection is done in the Front End (FE) phase, where appropriate project/ product definitions are made (Achiche et al., 2013). Unfortunately, at this early stage there is only a limited set of information available, which is referred by Smith and Reinertsen (1991) as a fuzzy environment as well. This environment is changing over time (Zhang and Doll, 2001) that there are unknowable and uncontrollable factors in the FE (Brem and Voigt, 2009). Besides, when the idea is not understood adequately, additional costs and delays might arise as well (Hirunyawipada et al., 2015). Consequently, the FE is important for the success of innovation projects (Jou et al., 2016), which simply emphasizes the importance of correct portfolio management of innovation ideas, and this leads to the following research questions:

Q1: Are there any antecedents of the innovation output, which shall be considered in the initial idea selection?

Q2: When given, what are their associated weights subject to be used in the evaluations?

Thus, first a literature review is made with respect of the antecedents of innovation in the FE idea selection, and then analytic hierarchical process (AHP) is

focused on as a suitable weighing method. Consecutively, the weights resulting from the application of AHP within a large enterprise in the metal industry are discussed, concluding with limitations and further research directions.

2. Literature Review

The FE of innovation is the first phase in the product innovation process, where idea generation and selection take place (Dewulf, 2013). In corporate management, the FE is one of the most important areas (Brem and Voigt, 2009). Consequently, the ideation (Cooper and Edgett, 2008) and the consecutive selection is widely covered by the NPD literature. It mainly relies on the Stage-Gate Model of Cooper (1990), where idea funnels are build up with stages as the processes for discovery, scoping and business case building. The selection and elimination of ideas are carried out in the associated gates after these stages. The assessment of ideas in a funnel is an iterative process carried out by groups. The idea generation, acceptance and realization are also called as the stages of the innovation process (Brem and Voigt, 2009). There, each iteration is a gate and during the stages the ideas are further detailed until the release of selected ideas. At higher levels of the idea selection, methods like the scorecard of Cooper (2011) are used, which e.g. do respect strategic fit, market opportunity, feasibility, competitive advantage and the reward. Sometimes, the stage-gate models are also combined with other techniques such as agile (Ahmed-Kristensen and Daalhuizen, 2015; Sommer et al., 2015). Similarly, there is the New Concept Development (NCD) model for the iterative idea evolution emphasizing the strategic perspective of business and technology opportunities in the FE (Koen et al., 2001; Koen, 2004). The product concept development is iterative starting with the opportunity identification/ analysis, idea genesis/ selection, and it is done before the product definition with the objective to go/no go decisions just like in the stage-gate model (Börjesson et al., 2006).

In all methods there is an evaluation/ selection of ideas due in order to organize the FE for innovativeness (Börjesson et al., 2006). Each project is of course unique, requiring a distinct approach (Bröring et al., 2006). However, the evaluation shall be made systematically with analytical tools to include all required aspects. Achiche et al. (2013) consolidated 29 different FE tools to support the innovation process, but these are distinct tools applicable to any circumstance

without any reference set for comparison and evaluation. Moreover, a high level of information is required to be able to apply all these tools. Consequently, companies applying a wide collection of tools are making subjective assessments limited by their knowledge (Bear, 2006), where they also use their own set of references.

All in one, there is a lack of streamlined comprehensive, but simple evaluation method of innovation ideas for the preliminary fuzzy FE (Kurt et al., 2017). Indeed, companies focus mainly on market acceptance, financial performance and product performance for the evaluation (Hart et al., 2003), but the contribution to the innovation stream is not always included, and the strategic perspective might be overseen as well. This occurs, because the majority of idea management in practice is neither organized nor systematic (Stevanovic et al., 2016). The requirements for the assessments within gates are company specific (Riel et al., 2013), leading to ad hoc and intuitively decisions (Stevanovic et al., 2015). Even existing scorecards such as of Cooper (2011) do indicate focal points, but do not imply early phase application methodology. However, an assessment formality in the FE is required for generating future business potential (Martinsuo and Poskela, 2011). Furthermore, the literature points out important factors at the FE also focusing on the back end to reduce the uncertainty (Börjesson et al., 2006). These factors do contribute at the early stage to the innovation output, thus from here on they are referred as the antecedents, which are focused on next to be grouped subject to be weighted then.

2.1. Value

Innovation is about added value, where ideas shall be transformed into commercial outputs (Jacobides et al., 2006; Innovation, 2017). During the selection of the ideas this transformation process shall be visible to the decision makers. There, the value capture shall include all perspectives of stake holders (Reypens et al., 2016), and innovation ideas can be selected based on that value (Salomo et al., 2007). The value shall be questioned for all stages of the innovation value chain, i.e. idea generation, development and diffusion (Hansen and Birkinshaw, 2007).

When talking about value, most companies do want to see crisp numbers. However, there are technical as well market value in addition to the pure financi-

al aspects, which establishment is challenging relying on the relationship between context and information (de Brentani and Reid, 2012). Consequently, direct revenue by product innovation and indirect value via business model innovation shall be respected (Bhidé, 2009; Amit and Zott, 2012). Sometimes, traditional accounting cannot measure the value of innovations such as in Information Technologies (IT) and/or services (Grant et al., 2013). Then, the value capture can only be realized by qualitative approaches such as in the value chain analysis of Porter (1998).

All in one, the value assessment represents a simple form of business model assessment. Especially, when the competitive advantage of internal resources is high for an innovation idea, the idea shall be leveraged to business opportunity (Snyder and Ebeling, 1997). Normally sales volume and margin, together along with market potential are used for business analysis (Hart et al., 2003). This requires lot of information, which is simply not available in the initial FE. Consequently, while successive gates can include detailed assessments such as the Business Model Canvas (BMC) of Osterwalder and Pigneur (2010), the initial gate shall be kept lean and have just a comparison of ideas with respect of the expected total value.

2.2. Applicability

Another important item to check for is the applicability of the innovation idea within the organization, i.e. there shall be a good fit with competencies (Salomo et al., 2007). There is always a positive correlation of future business potential with technical criteria (Martinsuo and Poskela, 2011), but the realization of these criteria shall be possible for the organization. Sometimes, the realization of an innovation idea might require new technologies, which are only possible by developing new competencies (Bröring et al., 2006). This can be even anticipated and leveraged for further development, but it shall be within the organizational absorption capability. Moreover, the developed technology shall interact with the market (Tidd et al., 2005), i.e. there shall be an adequate market potential that it can be sold (Cooper, 2011).

All in one, the feasibility shall be done successfully (Hart et al., 2003; Cooper, 2011), exploiting the integrated supply chain (Ursino, 2015). For that, the re-

sources of the organization shall be able to cover the expected additional efforts of the innovation project. This requires portfolio management (Cooper, 2003), which shall manage the aggregated allocation (Loch and Kavadias, 2002). This shall respect both the operating as well financial perspectives (Brem and Voigt, 2009) together along with time constraints. So, this evaluation shall respect beside personal allocations also schedules and break-even times with respect to companies' finance capabilities (Palmberg 2006; Calantone et al., 2014; Park et al., 2016). To do so, workshops and scenario groups may be allocated (Brem and Voigt, 2009) to discuss and grade applicability of innovation ideas as well.

2.3. Contribution to Innovation

In order to achieve an innovation organization, there shall be a constant flow of innovation projects (CEN/TS, 2013). At the FE, the concept novelty does increase the potential for business success, irrespective of short term performance (Martinsuo and Poskela, 2011). Moreover, the product uniqueness is a common criterion in NPD gates (Hart et al., 2003). Game-changing, bold innovation is required to succeed in a mature market (Cooper, 2011). This indicates that the portfolio management, i.e. the selection of innovation idea, shall emphasize the contribution to innovation as well.

During the assessments, important ideas with a lower preparation for the targeted context do indicate a high opportunity for innovation in the company (Ulwick, 2002). Consequently, as long as the organization can absorb it (Bröring et al., 2006), the portfolio management shall respect such ideas to support further development of the capabilities. This can also imply the reengineering of processes and thus process innovation. When also external know-how can be imported in such cases, costs and development time can be further reduced (Gronlund, 2010). This is simply open innovation (Cooper and Edgett, 2008) and thus shall be leveraged in the idea selection. Especially network-level innovation outcomes, i.e. collaborative outcomes, do contribute more to value (Reypens et al., 2016), thus they shall be emphasized as well. As a result, whether it is a process innovation or a product innovation (Tidd et al., 2005; Eliens, 2015; OECD, 2005), the contribution to innovation shall be rewarded during the initial selection of innovation ideas as well.

2.4. Generalization

The diffusion of innovation ideas across the organization is very important (Hansen and Birkinshaw, 2007). This has two aspects. First, they shall be communicated throughout the organization iteratively to enable the Ba, the moving and evolving context (Nonaka et al., 2000). Stakeholders need to know what these ideas are that they are able to adopt and apply them. Second, the achieved gain shall be diffused by the implementation to other similar applications. This is explained as the extension to the "adjacent possible", where the recombination of existing ingredients, i.e. innovation ideas, might generate more and better innovations (Johnson, 2010:41). So, ideas can lead to new ideas in an evolutionary iterative manner (Lewis and Elaver, 2014). Consequently, ideas applicable on a wide basis can attain a large cumulative value that the potential for such a generalization shall be looked at. This also would prevent the elimination of low value but high frequency ideas.

The generalization is also applicable from/to distinct technologies. When technologies and demand structures converge, suddenly different technologies come together, and one might benefit from other's rules, regulations and processes (Bröring et al., 2006). As a result, the cooperation and synergy from different actors might lead to open innovation (Chesbrough, 2006). This is very straight forward, simply because it takes existing structures and by generalization at organizational level it implements these structures in an innovative way to the organization. This requires less efforts, is easy to achieve and All in one, during idea selection, the opportunity of generalization shall be proactively assessed.

2.5. Strategy

Many leading companies did not manage disruptive innovations well that they didn't cope with the market and did lose their competitive advantage (Bower and Christensen, 1995). Changes in both, market as well technology, shall be foreseen by methods such as technology roadmapping to enable strategic planning (Phaal et al., 2004). Then all stakeholders shall work together according to a shared strategy of the company (Stamm, 2003) to achieve the desired innovation output (AT Kearny, 2017), which simply delivers a harmonized organization, where all efforts at operational level are towards the same direction, i.e. in-line with strategies (White and Bruton, 2010: 90, 102).

This implies that the idea selection shall respect the corporate strategy (Salomo et al., 2007; Cooper, 2009; Cooper, 2011; Martinsuo and Poskela, 2011), which then drives innovation (Stevanovic et al., 2016). The innovation portfolio is managed at the FE by ideation strategy, process formulization and creative encouragement, where ideation strategy implies the "alignment of idea generation and selection with the innovation strategy" (Kock et al., 2015). This emphasizes the development of a firm innovation strategy respecting the internal external environment as well (Tidd et al., 2005). Consequently, strategy and innovation do form each other (Morris, 2011; Eliens, 2015).

There are two main ways of innovation impulses: unsatisfied customers might drive the market pull or research delivers the basis of the technology push (Sandmeier et al. 2004; Brem and Voigt, 2009). Even if the innovation outcome is radical or even disruptive, i.e. bold, it "shall be strategically aligned to the business" (Cooper, 2011). Thus the usage of strategic criteria for the selection of the innovation idea in the FE does increase the future business potential (Martinsuo and Poskela, 2011). One last comment is that the best way is to generate strategic buckets for innovation ideas such as innovation typology, market, product area (Cooper, 2011), which all shall be respected during the selection and elimination of ideas.

2.6. Risk

Risk is another antecedent of innovation in the FE. There are always technical and market related uncertainties in NPD (Herstatt et al., 2006). Consequently, uncertainty and risk are innovation attributes (Gatignon and Robertson, 1991), and the potential discontinuation of innovation projects does increase the projected cost (de Brentani and Reid, 2012).

This is the perceived risk expressed, and it shall be addressed during the idea assessment (Cooper, 2008; Morris, 2011) by having a balanced portfolio (Martinsuo and Poskela, 2011), where even for bold innovation risk level shall be acceptable (Cooper, 2011). This simply implies that excessively risky projects are eliminated (Calantone et al., 1999).

However, this doesn't mean that all innovation ideas with a perceived risk shall be eliminated. When companies prefer only easy to research/ evaluate projects, they might end up with minor business potential (Burgelman and Sayles,

2004). Besides, it can be that the perception of risk is also not reflecting the truth. Consequently, it can be seen that companies, which perform best, do always have a larger amount of projects with a high level of innovation (see Table 1).

Table 1. Project portfolio distribution (%), based on (Cooper, 2011)

Innovation in	Worst Performers	Average Business	Best Performers
Promotion & package	12	10	6
Incremental improvements	40	33	28
Major product revisions	19	22	25
New to business products	20	24	24
New to world products	7	10	16

Thus, in the initial FE the risks of innovation ideas shall be assessed and the portfolio shall have accordingly strategic buckets for various innovation levels with dedicated different risk associations. This enables also the execution of radical innovation projects, which can even reduce risks in complex and instable environments (Chao and Kavadias, 2008).

2.7. Suitability of Existing Solutions

This antecedent is derived from the smE-MPower, CoachCom 2020 project of the European Union (Tsekouras et al., 2014), where the usage of an opportunity index is proposed for the idea selection. The opportunity index is defined by Ulwick (2002) as the sum of the strategic importance and the difference of the strategic importance and the satisfaction with current solutions. This represents the market perspective, where the usefulness for the customer shall be questioned (Hirunyawipada et al., 2015). If there are existing solutions, which are already available to the customer and capable to satisfy the needs, then the potential impact of the realization of the idea, i.e. the opportunity is less. Consequently, the suitability of existing solutions shall be assessed by market exploration in the FE (Jou and Yuan, 2016).

All in one the antecedents were found in the value, applicability, contribution to innovation, generalization, strategy, risks and the suitability of existing solutions (see Figure 2), which are then weighed next with the proposed methodology.

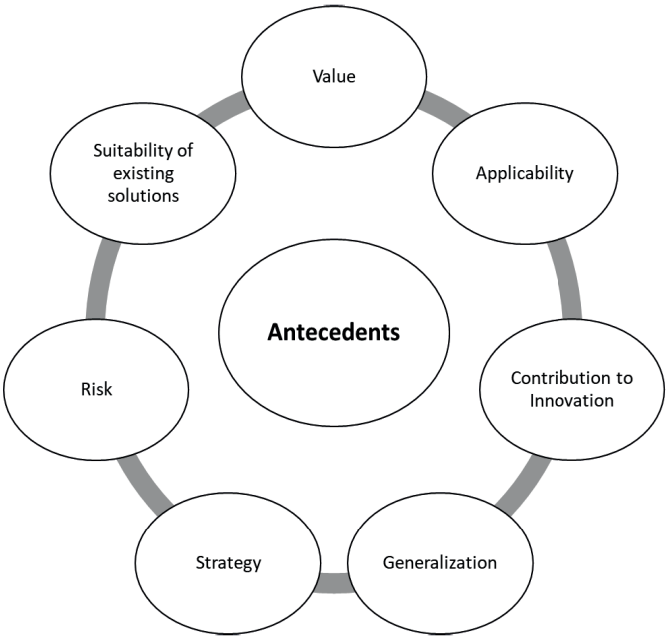

Figure 2. The antecedents of innovation

3. Data and Methodology

This study originated from the needs of companies implementing an innovation management system within the scope of the InoSuit project (TIM, 2017). The first run of the project did finish with 32 innovation mentors from 21 universities, who targeted to support the implementation of innovation management systems within 42 member companies of the Turkish Exporters Assembly. These numbers did change slightly during the project period of 11 months and by the time of this paper being written the second run already started with a new set of companies.

This particular work here does represent one of the tasks accomplished within the InoSuit project execution in a large industrial company from the metals industry. It simply aggregates the literature research, the field experience of the author and the lessons learned during the innovation idea selection/ assessment work carried out in an exemplified company, which is an old Turkish industry ins-

titution, established in different international locations with an annual turnover of over 1 billion US$. Furthermore, this proposed method was also presented and discussed in different meetings of the advisory board of the InoSuit Project as well in the mentor circles iteratively, meeting each 3 months during the total project time of 11 months.

In order to isolate the antecedents as mentioned before, a systematic literature review was made utilizing 73 scientific papers, 13 books, 2 technical standards/ reports and 5 other related resources after an initial screening of over 200 various resources determined by keyword search in WOS, Scopus and other similar scientific databases. Then interviews and several meetings/ workshops were made with the 10 members of the innovation committee of this company, who are in leading roles from various departments.

Consequently, a system for the idea selection in the initial FE was conceptualized, based on the Analytic Hierarchy Process (AHP) by the utilization of relevant factors; i.e. the antecedents. Then, the pairwise comparisons of these factors were made within this group to isolate the weights of the antecedents, which are further discussed at the end.

3.1. The Analytic Hierarchy Process (AHP)

Since distinct antecedents do span the solution space for idea assessment problematic, it is a multi-criteria decision making (MCDM) problem. Analytic Hierarchy Process (AHP) of Saaty (1980; 1990) is one of the most frequently used techniques for MCDM, enabling a structured lean decision environment (Ucler, 2017a). It is a widely used standard tool, transforming problems by using a simple hierarchy with several levels (Ucler, 2017b) arranging for factors of the decision (Pohekar and Ramachandran, 2004). Historically, AHP was extensively used for MCDM in supply chains (Arshinder et al., 2007) for the comparison of different products, services (Kahraman et al., 2004), or suppliers (Narasimhan, 1983; Nydick and Hill, 1992; Mohanty and Deshmukh, 1993). It was also used in NPD (Hsiao, 2002) for product design (Liu,2011) and weight determination of customer requirements (Ucler, 2017b). Among others Calantone et al. (1999) did use AHP in new product screening, and Huang et al. (2008) used it for the assignment of governmental funds to selected projects. All in one, it is suitable for the evaluation of alternative concepts (Ayag, 2005), which indicates the fit

of this method to the application here. Consequently, AHP was chosen for weighing of the antecedents of innovation, which can be then used in the initial idea evaluation at the early FE.

AHP is based on pairwise comparisons of criteria arranged in successive levels with hierarchical decomposition (Saaty, 1990). There are several scales for these pairwise comparisons (Ishizaka and Labib, 2011), assigning numbers to linguistic expressions, which also may include fuzzy number approaches (Ayag, 2005; Bozbura et al., 2007; Ucler, 2017a). However, the original fundamental scale of Saaty (1990) was adopted here for simplicity reasons, which implies 1 for equal importance, 3 for moderate importance, 5 for essential or strong importance, 7 for very strong importance, and finally 9 for extreme importance of one over another. The reciprocal values are being used as $a_{xy} = 1/a_{yx}$ for the inverse assessments.

These comparisons are then to be stored in a n x n matrix, which is square and positive (Shiraishi et al., 1998) with n criteria on both dimensions. This delivers the comparison matrix A with the eigenvector $\overrightarrow{w}$ and λ as the maximum/principle eigenvalue respecting $A\overrightarrow{w} = \lambda\overrightarrow{w}$ (Saaty, 1990; Saaty, 2003). This matrix is populated by different expert's opinions and it includes the comparisons of each criterion among each other. Consequently, when comparing e.g. X to Y, Y to Z and then X to Z, there might be some inconsistencies due to the chain of interactions. Thus the consistency ratio (CR) has to be checked. If the CR is inacceptable, the assessments of criteria can be re-evaluated in an iterative manner (Saaty, 2003). Since there are many open source codes and professional software packages available for the AHP computations, further details of consistency check as well the computation of the eigenvector are not given here, but Saaty (1990; 2003), Shiraishi et al. (1998), Alonso and Lamata (2006), and Ucler (2017a) give extensive information about the procedure, which can be used on demand.

Under the bottom line, if the CR is below 0.1, then the eigenvector $\overrightarrow{w}$ does represent the weights of the criteria under consideration (Forman, 1990; Saaty, 1990). Consequently, the application of AHP to the antecedents of innovation and their weighing is given next.

4. Results and Discussion

First of all, the seven antecedents as determined by the literature review were confirmed by the members of the innovation committee as applicable based on their cumulative work experience of over 150 man years. Indeed, the company did use in the past a proposal system for continuous improvement. However, the NPD conversion rate and the generated value was too low, that a system with new criteria enabling differentiation was welcome on board.

Then, the members completed pairwise comparisons of these antecedents, i.e. criteria, where high inconsistencies with a CR of 14.2% aroused by averaging several opinions with deviations. Thus, the geometric mean was used according to Bozbura et al. (2007) lowering the CR to almost 12%. Since this was also not a satisfactory result, an iterative approach was established to have consensus (Saaty, 1990; Saaty, 2003; Alonso and Lamata, 2006). During AHP computations the open source software of Goepel (2013) was used, which also indicated the main sources of inconsistencies during iterations, which were discussed in the group. After 3 iterations of pairwise comparisons consensus was reached with a CR of 9% and the AHP computations did deliver associated weights and the ranking as shown in Table 2.

Table 2. The comparison matrix, weights and rank of criteria

Nr.	Criterion	*1*	*2*	*3*	*4*	*5*	*6*	*7*	Weights (%)	Rank
1	Value	1	2	3	1/2	1	1/3	1	12	4
2	Applicability	1/2	1	2	1	3	1/4	7	15	3
3	Contribution to innovation	1/3	1/2	1	1/2	3	1/3	3	10	5
4	Generalization	2	1	2	1	3	1/2	3	18	2
5	Strategy	1	1/3	1/3	1/3	1	1/4	2	8	6
6	Risk	3	4	3	2	4	1	3	32	1
7	Suitability of existing solution	1	1/7	1/3	1/3	1/2	1/3	1	5	7

α=0,1; CR=9% for consensus after 3rd iteration; all weights rounded adequately.

Based on these weights the decision hierarchy for the idea selection was set up (see Figure 3). This enabled a framework for the analytical assessment of ideas at the front end, where all ideas are to be graded with respect to each antecedent (S_i). This in turn delivers an aggregated score (*SCR*) of the idea when

summing up the products of S_i's and associated weights (w_i) as $SCR = \Sigma_i S_i w_i$ with i=1 to 7. The risk scored highest placing the first rank, which was interpreted as an outcome of the protective behavior of the managers. This antecedent must be evaluated with care in the early FE, which by definition includes uncertainty and environmental instability.

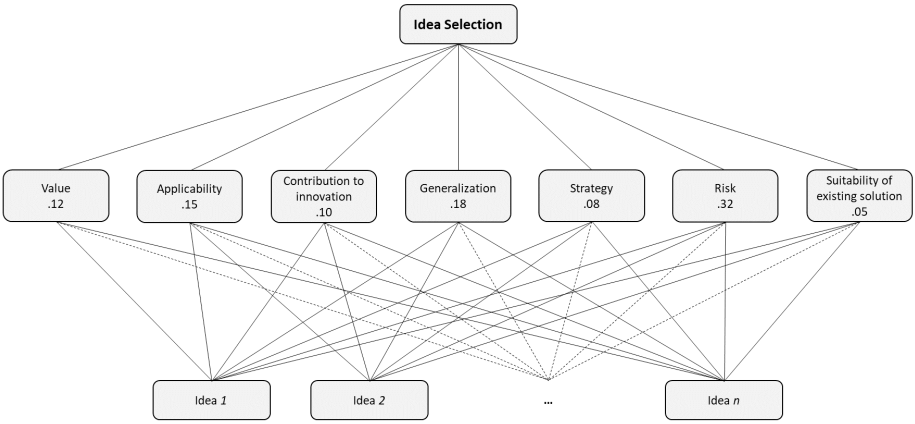

Figure 3. The selection hierarchy

When these two are present, "the common notations of risk and reward are reversed that incremental innovation delivers higher performance and higher risk relative to radical innovation" (Chao and Kavadias, 2008). This can be seen as the risk to miss the advancements hindering the adaptation of new technologies that all strategic buckets of Cooper (2011) are respected delivering a balanced portfolio for incremental and radical innovation (Chao and Kavadias, 2008). Consequently, the assessment of the risk shall include also the risks associated to when not realizing the innovation ideas. Only then the risk of inhibition of an opportunity due to the uncertainty (Kim and Wilemon, 2002) can be avoided.

The generalization was ranked two, which is an enabler of Hansen and Birkinshaw's (2007) diffusion. It is simply focusing on whether there are possibilities to transfer the novel approach to distinct occasions, which is also supporting the adjacent possible as described by Johnson (2010). The result was appreciated by the managers a lot, since they did emphasize the application of easy to achi-

eve best practices across the organizations. Especially this can be beneficial for large organizations with distinct locations.

The applicability did rank three with almost 1/7 weight among 7 antecedents, focusing on both, market as well technical feasibility. Close to that the value was forth with a weight of 12%. These areas are historically looked at from all NPD professionals such as Cooper (2011) and thus this result was expected.

Strategy scored a lower weight with 8%, which can indicate that either there is a lack of streamlining the strategy within this specific organization, or the novelty of an idea can overcome the strategy. This interesting topic was discussed further with the group and the second possibility was found to be more applicable. This was assumed to be in connection of the large size of the company: The experts did emphasize more on the novelty, because they were not limited in organizational boundaries, but were open to investments leading to open innovation of Chesbrough (2006) as well. However, further research on this aspect is suggested.

The suitability of the existing solution was ranked seven as the least important antecedent. This is based on the fact that the applicability did include some of the market information as well. There were discussions whether this antecedent shall be classified under the applicability as well, however since existing products of the market and of the company itself shall be explicitly looked at, it was found to be important to compute the opportunity index of Ulwick (2002), which is also connecting to the strategy as well.

All in one, the 7 antecedents were also deliberated comprehensive, covering also the 12 score card items of Cooper (2011), looking particularly for strategy, market, feasibility, competitive advantage and reward in the early FE. These antecedents were found to be easy and understandable from the practitioner point of view that their application in the early FE was preferred. Moreover, the endeavor for consensus via iterations in weight determinations was not only allowing mathematical simplicity, but also enhancing the communication and understanding of stake holders' perspectives within the group. This increased internal linkages, which usually support innovation (Cornetto et al., 2016). It was also observed that there were many incomplete idea submissions just isolating problems without concrete proposals. During the iterations the committee mem-

bers did work collaboratively to understand these issues. According to Hansen and Nohria (2004) collaboration across different perspectives deliver innovation by cross-pollination. Indeed, there were either innovation ideas arising from the evaluating committee or plans for call based actions around these problems, which did lead to innovation as well.

To further support open innovation, the inclusion of external stake holders such as suppliers and customers in the FE were also considered. However, since there are challenges associated to the total integration of external stakeholders to the innovation process in the fuzzy FE (Jörgensen et al., 2011), the proposed method here did not include their direct inclusion in the initial assessment, but instead ideas across organizational boundaries were welcome. This did import external know-how leveraging innovation (Cooper and Edgett, 2008), cutting costs and development time (Gronlund, 2010). Although this only enables unidirectional sequential information flow, it was preferred for practical reasons. But it was also concluded to include such external stake holders in later phases during the hands-on NPD that further synergy can be benefitted of.

All in one the weights did deliver the framework for the idea assessment, where further details on the examples were avoided here due to confidentiality. Instead an illustrative assessment is exemplified in Table 3, where three different ideas A, B and C were assessed yielding in the highest score as 4.16 for idea A as being selected in this mini example.

Table 3. Illustrative assessment example

		Grades for antecedent								
Nr.	**Idea**	***1***	***2***	***3***	***4***	***5***	***6***	***7***	$\overrightarrow{w}$	**SCR**
1	A	1	5	1	1	1	9	1	0.12 0.15	4.16
2	B	7	5	5	1	9	1	5	0.10 0.18 0.08	3.56
3	C	1	5	3	3	3	1	1	0.32 0.05	1.32

It can be seen that the high contribution to the strategy did support the selection of idea A. Nevertheless, the idea B also did also score high despite a low strategic contribution. This relied on the higher contributions to the value, applicability and the contribution to innovation. In real life strategic buckets of

Cooper (2011) were set to be populate by the ideas. So, in real life it is not the selection of a single idea among three, but there is a long list of ideas with associated scores, and the scores are being used to address each bucket appropriately. This approach enables a scoring rather than elimination of ideas. Thus, it can be used to fill these buckets with quality ideas indicated by their higher scores.

5. Conclusions

It is obvious that successful companies need to be innovative. The innovation efforts are mainly streamlined with innovation management systems, which enable companies to develop continuously, differentiate in new products, services/ processes. Therefore, ideation and the successive idea selection at the early FE is a prerequisite. This is a complex task in a multidisciplinary environment, requiring analytical portfolio management utilizing MCDM to avoid ad-hoc conclusions.

Consequently, first a literature research was conducted to isolate the antecedents of innovation. These were isolated as (i) value, (ii) applicability, (iii) contribution to innovation, (iv) generalization, (v) strategy, (vi) risks and (vii) suitability of existing solutions. Then, based on the expert information the applicability of these antecedents were confirmed for the initial idea selection at the early FE. After that, AHP was used to weigh these antecedents based on pairwise comparisons that an analytical framework was delivered for idea assessment. The weights of the antecedents were computed as (0.12; 0.15; 0.10; 0.18; 0.08; 0.32; 0.05) respectively, which can be used to determine final scores of ideas as a sum of their products with their individual grades for the antecedents. Finally, the usage of this approach was shown by a simple illustrative example.

Consolidating the academic knowhow and industrial practices, this work contributes to the literature by first pointing out the areas to look at during ideation for a high impact on the innovation potential of the company. Second, since there is no comparable scale applicable to the selection in the very early phases of ideation, this weighing represents a novelty as well. Moreover, it is also delivering a managerial tool, which can be implemented easily to increase the innovation output within the stage gate approach. This tool was proven to be handy during the TIM's InoSuit project that it is shared herewith as a good practice. Furthermore, the iterative nature of this approach is also enhancing the

collaboration among the organization. This is enabling the circulation of ideas across organizational boundaries as well. All in one it is an enabler for the appropriate innovation environment accessible to all stakeholders.

Nevertheless, there are some limitations. The first limitation is that the industry experts and the contributing academicians are all from a single country. Thus the application and testing of internationally accepted literature was conducted only on local basis. On the one hand this summarizes local perceptions, i.e. it is a novelty itself, on the other hand it is restricting the generalization of the weights on international basis. This can be looked at later on. The second limitation is the fuzzy extend. For simplicity reasons a fuzzy AHP was not conducted. Further research can be done in this field as well. Finally, the weighing is representative for mature, large organizations. Consequently, further research can be conducted to focus on the variation of the weights of the antecedents with respect to organizational sizes.

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