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Laurea University of Applied Sciences
Ratatie 22, 01300 Vantaa, Finland
Phone +358 (0)9 8868 7150
Fax +358 (0)9 8868 7200
firstname.surname@laurea.fi
www.laurea.fi
Business ID 1046216-1
Domicile Vantaa

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# Managing Human Factor at the Fuzzy Front-End of Innovation

Teemu Santonen*

Laurea University of Applied Sciences
Vanha maantie 9, 02650 Espoo, Finland
E-mail: teemu.santonen@laurea.fi

Kaisa Hytönen

Laurea University of Applied Sciences
Ratatie 22, 01300 Vantaa, Finland
E-mail: kaisa.hytonen@laurea.fi

* Corresponding author

**Abstract:** The fuzzy front end of innovation (FFE) is attributed to the early phase of the innovation process. Selecting the best ideas for further development is critical for business success. However, the existing FFE literature has mainly focused on the idea generation processes, whereas studies regarding idea selection processes are significantly less representative. By following cross-disciplinary research strategy, this theoretical and methodological concept development study identifies factors from psychology, behavioural sciences and neuroscience which can influence individual person's decision-making process during the FFE idea selection stage. Moreover, we discuss the impact of the identified factors in incremental vs. radical idea selection processes in order to evaluate the possible differences between these two very different idea types. As a result it is concluded that radical idea selection process appears to be more systematically negatively influenced by choice biases whereas choice biases have more scattered influence on successful selection of incremental ideas.

**Keywords:** Fuzzy Front End of Innovation, Decision making, Idea selection, Idea screening

## 1 Introduction

The fuzzy front end of innovation (later FFE), a term coined by Smith and Reinertsen (1991) is attributed to the early phase of the innovation process (Cooper, 1988) and typically includes stages from the idea generation to decisions on further development (Nobelius and Trygg, 2002, Jetter, 2003). The existing FFE literature has mainly focused on the idea generation, whereas studies regarding idea selection (also known as idea screening process, Toubia and Florès, 2007), is significantly less representative (Girotra et al. 2010). Selecting the best ideas for further development is critical for business success, since a great majority of whole life cycle costs and features are defined at the FFE stage (Wagner and Ehrenmann 2010). Due the limited amount of information about

an idea, decision making in FFE stage is done less rigorously and in more uncertain conditions than in later innovation process stages (Zhang and Doll 2001; Koen, 2001). Over the years, a comprehensive set of various systematical criteria, guidelines and tools have been proposed to improve FFE decision making processes (Hammedi et al. 2011; Riedl, et al. 2010, Carbonell-Foulquié et al. 2004). Nevertheless, organizations are still poorly managing their FFE processes (Barczak et al. 2009). Moreover, the FFE decision making studies have mainly focused on the selection criteria definition (Carbonell-Foulquié et al. 2004; Cooper, 2001) and team based decision making in various settings (Faure, 2004; Rietzschel et al. 2006; Onarheim and Christensen, 2012). Only a few pioneering studies have evaluated how an individual person is making decisions at the FFE (Ritter et al. 2012). This is a major research gap, since new knowledge and creativity always starts from individual efforts, which only later on can be transformed into valuable organizational knowledge to contribute innovation process (Nonaka, 1991). By following cross-disciplinary and bibliographical search research strategies, this study identifies factors from psychology, behavioral- and neuroscience disciplines which can influence individual person's decision making process during the FFE idea selection stage. As a result, this study can be characterized as a theoretical and methodological concept development.

## 2 Selecting ideas at the Fuzzy-Front-End of Innovation (FFE)

Idea section at the FFE stage is typically performed by a cross-functional team (Cooper, 1994), which uses various screening criteria and factors (Cooper and de Brentani, 1984; Carbonell-Foulquié et al. 2004) and requires multiple iterative decision making stages (Koen et al. 2001). Nowadays due flexible communication channels, companies are also increasingly involving consumers (Toubia and Florès, 2007) to evaluate ideas e.g. via crowdsourcing platforms. The prior studies evaluating team based FFE decision making processes have compared effectiveness of interactive and nominal groups (also known as hybrid group) in which individuals perform first in isolation with no interaction and whose productivity is later on combined (Stroebe et al.1992; Paulus et al. 1993). A long stream of studies have shown that nominal groups outperform interactive groups in terms of number of generated ideas (Mullen et al. 1991). However, nominal group's performance (Rietzschel, 2005; Rietzschel et al. 2006) or satisfaction with the selected ideas (Faure, 2004) is not superior over interactive group though some studies have found some support for nominal group's better ability to assess the quality of ideas (Girotra et al. 2010). Making group to select either their own ideas or ideas from other groups, have different effect on performance and motivational outcomes of the group (Faure, 2004). This highlights the importance of group composition during the idea selection process and stresses the role of an individual person as a decision maker.

Furthermore, studies evaluating idea selection method studies have resulted contradictory outcome. Some studies argue that multi-attribute scales should be favored over simple rating mechanisms (Riedl, et al. 2010) whereas Ritter et al. (2012) proposed that unconscious decision making process is able to detect most creative ideas. Thus, it is not surprising that many organizations have relied on an informal and unsystematically idea screening process rather than formal analysis (Calantone et al 1999) which furthermore tend to be a political and champion-driven activity (Barczak et al. 2009). Stimulating openness and argument based discussion, allowing team member to a stop-

and-think, and adapt available tools and models only when they are needed, can be implemented to improve team based idea selection abilities (Hammedi et al. 2011). As a result of this literature review, we argue that the theoretical frameworks and practical guidelines how organization should manage the idea selection process from individual person point of view are limited.

## 3 Research methodology

### *3.1 Research design*

First, a bibliographical search was conducted by a seasoned researcher focusing on innovation management to identify all the relevant studies relating FFE decision making process at the individual person level. As argued in previous sections, a clear research gap was identified. A need for a cross-disciplinary research strategy (Kockelmans, 1975) – collaboration beyond single discipline borders (Frank, 1988) – as well as the theory and investigator triangulation research approaches (Downward and Mearman, 2007) was evident. There is a rich stream of studies in psychology, behavioural sciences and neuroscience which are focusing on the individual person's decision making processes in other decision making settings besides idea selection. Therefore, we cannot limit the bibliographical search on single academic disciplines a.k.a. a branch of knowledge (Aram, 2004) such as innovation management or idea selection at FFE stage.

The second bibliographical search was conducted by a seasoned researcher focusing on decision making within psychology, behavioural sciences and neuroscience. The idea of recombining or borrowing existing knowledge from other domains in order to generate innovations can be traced back to Schumpeter (1939) and it has successfully been applied also in the field of innovation management (Gassmann et al. 2014). The main aim in disciplinary paradigms is to combine the strengths of two or more different scientific disciplines and try to solve problems with a more diverse knowledge base. In general, there is a growing trend of research collaboration and multi-authored papers in science (Santonen and Ritala, 2014) in order to increase the quality and quantity of scientific output (Barnett et al., 1988) by harnessing specialization within disciplines (Laband and Tollison, 2000).

Based on the cross-disciplinary literature review, a list of factors relevant at the FFE decision making process at individual person level were identified. Each factor's impact to incremental vs. radical idea selection process were compared in order to identify similarities and differences between these opposite ends of the innovation continuum (Veryzer, 1998; Dewar and Dutton, 1986; Gillier et al. (2010) although this classification approach is not without criticism (e.g. Henderson and Clark, 1990). According to Santonen et. al. (2007) *"Idea is a novel representation in an individual's mind relating to conception or notion of something to be done or carried out. At the first stage, novel thinking is an intention or plan in an individual's mind, which arises from the individual's creative thinking process. In the second stage after the individual's thinking process, the individual shares his/hers idea with other people by verbal or written communication"*. Moreover by following Santonen (2012) we argue that *"idea is always the starting point, plan or intention for potential innovation. Idea changes to innovation during the successful execution process. Without the successful execution, the idea will not change to innovation"*.

In this study, we consider incremental idea as an improvement of exiting offering (e.g. Myers and Marquis, 1969) by introducing minor changes (Henderson and Clark, 1990), thus causing also minor uncertainly and minor performance improvement. However, giving unambiguous definition for radical idea is more complex tasks since the current typology of radical innovation is overly complex and has led to overlapping and parallel definitions (Kristiansen, 2014). Due the ambiguous definitions of radical innovation, in this study we focus our comparison mainly on the uncertainty dimension, which is also closely related to the degree of newness and change (Dahlin and Behrens, 2005; Baregheh et al. 2009). As a result in this study we propose following simplified definitions for incremental and radical idea when evaluating how each factor is assumed to influence on FFE decision making process:

***Incremental idea (a.k.a ex ante innovation):*** *The level of change, uncertainty and investment is low but the performance improvement of the successful implementation is typically low although immediate.*

***Radical idea (a.k.a ex ante innovation):*** *The level of change, uncertainty and investment is high but the performance improvement of successful implementation can be substantially high although redeem of gains will take substantially long period of time.*

Furthermore, in this study we are assuming that an individual is making idea selections decision in the following setting: "as a member of a cross-functional team, using either multi-attribute scales or simple rating mechanisms to make final go/no-go decision before new product development (NPD) or new service development (NSP) process." Authors are aware of that FFE process typically includes multiple iterative decision making stages before the final go/no-go decision (Koen et al. 2001). However, in order to amplify the possible difference between incremental and radical idea, the final decision making stage in FFE is selected.

### *3.2 Construction of key measures*

In a successful decision-making process the actions taken by the decision makers are consistent with goal attainment (Heitmann et al. 2007). By following Baregheh et al. (2009) the relevant goals in an innovation process are "transforming ideas into new/improved products, service or processes in order to advance, compete and differentiate organization successfully in their marketplace". Successful implementation can lead to minor (incremental) or substantially high (radical) performance improvement. Thus, we argue that the key goal in FFE process is "selecting the best possible ideas for further development, which can lead to the highest performance improvement when considering also the expenses and risks".

The presence of choice biases and heuristics in individual behavior can influence the quality of decisions in the FFE process. In decision-making process outcome evaluation is one of the final stages (Rangel et al. 2008) and often people infer, rightfully or not, the quality of decision-making process based on its outcome (Baron and Hershey, 1988). In simple decision-making tasks outcomes have been found to create dissociable neuronal and affective reactions according to their valence (better vs. worse outcome than expected) and magnitude (low vs. high) (Connolly and Zeelenberg, 2002; Delgado, 2003). In emotion research, emotions are quantified according to their valence and

arousal (Russell, 1978, 1991). *Valence* evaluates the impact on a continuum varying from pleasure to displeasure. *Arousal* describes emotions ranging from high activity to sleepiness and dominance contrasts potency to submissiveness. Based on these approaches, we evaluate the impact of each decision bias on the expected goal attainment in respect to two orthogonal dimensions: valence and impact. For our research purposes we propose following scales:

***Valence:*** *The impact of decision biases on a scale from negative (-) through neutral (0) to positive (+).*

***Impact:*** *Quantifies the strength of the impact from low to high*.

## 4 Managing The Human Factor at the FFE Decision Making Process

In the Appendix Table 1 we have compared and summarized each factor's influence on incremental vs. radical innovation decision making process. In the following we will construct our propositions.

Many decisions are social by nature and take place in interactive environments. In social groups people establish descriptive and injunctive norms that guide the behaviour of group members. In general decision makers are strongly influenced by the actions and opinions of other people and conform to the behaviour of others (Cialdini and Goldstein, 2004) by learning to behave as other (similar) people around them do (Klucharev et al. 2009). Thus, we argue that tendency to avoid voicing and supporting divergent opinions in groups can be detrimental to both incremental and radical idea selection (Proposition *P1: Norms*).

People are even more influenced by a person with perceived formal or informal authority and by people one likes (Cialdini and Goldstein, 2004). Social status is thus beneficial for an individual. This is reflected in the decision behaviour as a tendency to take actions which improve social status (Hardy and Van Vugt, 2006; Anderson and Kilduff, 2009). Overweighting the opinions of high status individuals can prohibit radical idea selection since high status people are often in-group members and may be oblivious to radical viewpoints, and newbies do not want to differentiate themselves too much from the rest of the group in order to avoid the risk of social exclusion. In incremental idea selection the prior experience and familiarity with the current status and history might in contrast be considered an asset (*P2: Social status*).

Another important factor in social decision-making environment is reciprocity and trust which relate to other-regarding preferences in human behavior. Reciprocity refers to the tendency and feeling of being obligated to reciprocate and repay a previous favours. Decision makers also show trusting behavior towards each other, and repay trust by behaving in a trustworthy manner (Berg et al. 1995; Fehr, 2009). We propose that in an FFE process reciprocity and trust result in weighting of in-group opinions (trusting relationships have been built in the past) higher than the opinions of others. For radical idea selection this is detrimental with similar arguments than status, but for incremental ideas the impact of reciprocity and trust might be more positive than the impact of status due to the high performance incentive of being trustworthy (*P3: Reciprocity and trust)*.

Other-regarding preferences are also indicated by inequity aversion. Decision makers dislike inequity and unfair behaviour (Bazerman and Moore, 2013) so much that they are

willing to punish, even at their own expense, the observed unfair behaviour towards a third party (altruistic punishment) (Fehr and Gächter, 2002; Rilling and Sanfey, 2011). In idea selection, inequity aversion might promote fair cooperation among the decision-makers which should promote equal attention on each member viewpoints when making decisions. We thus expect weak positive impact of inequity aversion (*P4: Inequity aversion*).

Individual decision-making is influenced by many factors. First of all, decision making is restricted by limited cognitive resources. Decisions are guided mostly by salient information that reaches decision maker's attention. Attention is often placed on those aspects that are most familiar, easy to grasp, surprising or novel, or most relevant from the perspective of reaching goals (Corbetta and Shulman, 2002; Bazerman and Moore, 2013). We argue that since attention is placed on the most salient issues and solutions, it does not support radical idea selection. In contrast for incremental ideas it may be beneficial to concentrate only on the most salient issues (*P5: Salience*).

In many cases decision makers also follow their habits and routines, and finding it challenging to change behaviour (Verplanken et al., 1998; Verplanken and Wood, 2006). This type of automated behaviour often leads to the acceptance of the status-quo or a preselected option even though in the absence of a default option one might choose a completely different course of action. (Bazerman and Moore, 2013; Johnson and Goldstein, 2003). Similarly to salience, we claim that defaults are detrimental for radical ideas. For incremental ideas, however, the use of default solutions may be more harmful than attention on salient aspects, since defaults direct decision makers into making no change (*P6: Defaults*).

Decision-makers evaluations and preferences for options and outcomes are not consistent across situations and time. People experience events and outcomes as gains (improvements) or losses (deteriorations) in respect to a reference level, e.g. status-quo. Decision makers react to potential or realized losses relatively stronger than they do for gains: losses are experienced on average twice as strong as equally-sized gains (Kahneman and Tversky, 1979). In addition to prospective gains, radical ideas often include also salient potential losses. We suggest that overweighting of losses may lead to excluding radical ideas that may have a positive expected return. Incremental idea selection may also be impacted by loss aversion, but effect might be smaller with less uncertain factors and smaller stakes (*P7: Loss aversion*).

Decision-makers preferences are also not consistent across time but instead they show present-biased preferences. Any deviation from "now" is psychologically discounted relatively stronger than any similarly sized time interval in the future (Frederick et al. 2002). This leads to the tendency to give more weight to the events that occur now vs. later that is indicated for instance by the general preference for receiving rewards today and leaving painful costs for later. Another consequence is the tendency to procrastinate and leave inconvenient tasks for later (O'Donoghue and Rabin, 1999). Relevant time-frame in radical innovations is generally long. Thus weighting immediate rewards in idea selection is disadvantageous while procrastination is not as relevant. In contrast, time scale of incremental innovations is tight and early rewards are expected. Procrastination in decision making might lead to an opportunity loss (*P8: Immediate rewards; P9: Procrastination*).

Most decisions are done in situations where uncertainty is present. Decision makers are generally aversive towards such option where they do not know for sure what will happen. More in detail, decision makers in general prefer avoiding risks and ambiguity

and have a high premium for certainty (Bazerman and Moore, 2013). In uncertain environments, people also tend to give disproportionately high weight to unlikely events by weighting small probabilities more than one should (Kahneman and Tversky, 1979). This leads to for instance buying lottery tickets and insurances that have negative expected overall value. If an idea is novel, it almost certainly includes some unknown factors, and thus we propose that the impact of avoiding uncertain options is negative in the selection phase. Similarly overweighting of unlikely events can lead to long-shot choices. Since radical innovations include more uncertain aspects than incremental innovations, the impacts are stronger in radical than incremental idea selection (*P10: Aversion for not knowing; P11: High impact of unlikely events*).

Decision-makers can also have inaccurate perceptions of their decision-making capabilities and conditions. In general, people tend to be overly optimistic about their own skills, knowledge-level and precision, and believe to perform above average in the population. Overconfidence is also linked to an illusion of being in control of situations (even when not) (Bazerman and Moore, 2013; Camerer and Lovallo, 1999; Klayman et al. 1999). Incremental and radical ideas differ in the amount of knowledge behind the choices. Incremental idea selection is done in an environment where many facts are known and thus we claim that confidence reflects more closely true knowledge than in radical ideas. On the contrary, in radical ideas a lot is unknown and overconfidence can bias decision making (*P12: Overconfidence*).

Decisions are also influenced by the emotional state of the decision maker. Affect and emotions modulate choice behaviour for instance though mood: Decision makers tend to be optimistic and light-hearted when making choices in a good mood and more pessimistic and analytical when in a bad mood (Schwartz, 2002; Isen, 2000). Furthermore, in early judgments of innovations affect influences the perception of risks and benefits (King and Slovic, 2014). We argue that since we have less information in the radical than incremental idea selection we are relying more on affect heuristics than actual quantifiable facts. In both cases however we expect that the emotions bias the idea selection in a negative way (*P13: Affect*).

## 5 Conclusion

We conclude that radical idea selection process appears to be more systematically, strongly and negatively influenced by choice biases whereas choice biases have more scattered influence on successful selection of incremental ideas. However, since this study is by nature a theoretical concept development, there is a need to verify our claims in empirical studies. Furthermore, we suggest that in future studies it is important to evaluate the impact of choice biases not only between incremental and radical idea selection processes but also to consider the influence of diverse business environments, such as organization type, industry and cultural diversity.

We recommend that the presence of the choice biases is acknowledged in the idea selection process and that different techniques are deployed to minimize the assumed impacts of choice biases. These methods may differ for radical and incremental idea selection due to the differential impact of choice biases. It is noteworthy that some of the biases are relevant on group-level decision making while others are also relevant in isolated decision making done by an individual.

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## Appendix: Table 1: Comparison of each factor's influence on incremental vs. radical idea decision in final FFE go/no-go stage

| *Factor name* | *Incremental idea* | | | | | *Radical idea* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Valence* | | | *Impact* | | *Valence* | | | *Impact* | |
| | *-* | *0* | *+* | *Low* | *High* | *-* | *0* | *+* | *Low* | *High* |
| 1. Norms | x | | | | x | x | | | | x |
| 2. Social status | | | x | x | | x | | | | x |
| 3. Reciprocity and trust | | | x | | x | x | | | | x |
| 4. Inequity aversion | | | x | x | | | | x | x | |
| 5. Salience | | | x | | x | x | | | | x |
| 6. Defaults | x | | | | x | x | | | | x |
| 7. Loss aversion | x | | | x | | x | | | | x |
| 8. Immediate rewards | | | x | | x | x | | | | x |
| 9. Procrastination | x | | | | x | | x | | x | |
| 10. Aversion for not knowing | x | | | x | | x | | | | x |
| 11. High impact of unlikely events | x | | | x | | x | | | | x |
| 12 Overconfidence | | x | | x | | x | | | | x |
| 13. Affect | x | | | x | | x | | | | x |