Journal of Innovation Management
JIM 3, 4 (2015) 42-69
HANDLE: http://hdl.handle.net/10216/81805

Is Time Pressure an Advantage or a Disadvantage for Front End Innovation – Case Digital Jewelry

Erno Salmela[1], Ari Happonen[1], Marika Hirvimäki[2], Ivary Vimm[1],

[1] Lappeenranta University of Technology, Innovation and Software, School of Business and Management, Lappeenranta, Finland

{erno.salmela, ari.happonen, ivary.vimm}@lut.fi

[2] Lappeenranta University of Technology, Department of Mechanical Engineering, Lappeenranta, Finland

marika.hirvimaki@lut.fi

Abstract. Time pressure is not usually seen as an advantage in front end innovation (subsequently referred to as "FEI"), but rather it is believed that ideas should be left to develop freely without a tight schedule. Instead of strictly formalized operations, creating ideas generally necessitates a certain level of freedom. The starting point for this research was to challenge this general view by imposing severe time pressure in FEI. The FEI process was reviewed from recognizing problems/creating ideas up until the selection of the best concept for further development. The research was executed as a qualitative in-depth investigation of a case. In the case, FEI took place over a three-week period, and the target for the FEI was to generate concepts of digital jewelry with business potential. The time pressure was seen as appropriate – with certain conditions – in FEI. The results also present the advantages and disadvantages of time pressure, combining it to the stress theory.

Keywords. Management of Human Resources, Co-development, Product Development, Digital Technology, Front End Innovation, Time-pressured Innovation, Innovation Management, Collaboration, Co-creation, Digital Jewelry, New Technology, Case Study, Stress Theory.

1 Introduction

Increased global competition, shorter product life cycles, and faster technological development have made a fast go-to-market strategy an essential competitive factor (Defee and Fugate, 2010; Langerak et al., 2010). As a result, speeding up innovation and development has become a critical objective of innovation management (Acur et al., 2010). It is important to recognize the success factors which help innovation and development projects succeed regardless of time pressure (Chen et al., 2010). Usually, process acceleration has been considered to be a factor that reduces the originality of innovations (McDermott and Handfield, 2000). Instead of the acceleration and formalization of the innovation process, flexibility has been seen as an important factor for success in radical innovations (Chiesa et al., 2009) – especially in front end innovation (subsequently referred to as "FEI") processes (Vandenbosch and Clift, 2002; Bierly, 2002).

The pursued quality of the ideas should be taken into consideration in FEI. Often the

ISSN 2183-0606
http://www.open-jim.org

goal is to create 'great ideas' prior to deciding to begin the development work. However, there are opposing views on what the best goals are for FEI as part of an end-to-end innovation process for the full process to be as successful as possible. It is said that starting with a mediocre idea and testing its functionality quickly in the field of expected use case environments is more important than the creation of great ideas. With the feedback from the field, great ideas can surface iteratively. Therefore, the quantity of iterations should be increased to create great ideas. Of course, this depends on the context in which the innovation is performed (Sims, 2011).

Innovation work and activities have been studied a great deal at a conceptual level but in-depth context-sensitive information is still lacking (Langerak and Hultink, 2008; Crevani et al., 2011; Kach et al., 2012). Thus, there is a need for micro-level innovation research in which innovation is studied at a detailed level in a certain environment (e.g. individual field/organization), in a certain innovation target (e.g. product or process), in a certain phase of the innovation process (e.g. FEI), and regarding a certain innovation type (e.g. radical or incremental innovation) (Nobelius and Trygg, 2002; Langerak and Hultink, 2008; Crevani et al., 2011; Kurkkio, 2011).

In addition, at a detailed level, there is also very little research on how time pressure in FEI affects the outcomes. For example, what advantages and disadvantages are caused by time pressure related to the goal of FEI. This article focuses on this phenomenon by studying one innovation case with severe time pressure on FEI and examining the consequences. In the studied case, a heterogeneous group of 27 persons with different industrial and academic backgrounds radically created ideas and conceptualized new products, namely digital jewelry (Fig. 1.). Digital jewelry refers to electronics and information technology embedded in jewelry, which provides opportunities to produce new kinds of value for the users. Alongside the esthetic and emotional value of traditional jewelry, digital jewelry could have a strong functional value element, as well. Furthermore, digitalization may strengthen the traditional value elements of jewelry.

Fig. 1. Prototype of a digital effect jewel for the movie Iron Sky: The Coming Race.

This article proceeds as follows. The following section examines time-pressured, collaborative and radical FEI based on earlier scientific literature, connected to the research of productivity vs. level of stress as part of the work process, and finally presents the theoretical framework applied in the study. This is followed by the research methodology. Subsequently, section 4 presents the background of the innovation case which was the target of the research. This is followed by the analysis and results of the case study. Then, the findings and the theory are discussed. Lastly, the conclusions and the need for further research are presented.

2 Time-pressured front end of collaborative and radical innovation

This section discusses concepts and theories important for the research context, including FEI as well as radical, collaborative and time-pressured innovation, with connections to the stress level vs. productivity research.

2.1 Front end innovation

Theoretically, an innovation process is divided into three main phases: FEI, development, and commercialization (Koen et al., 2002). FEI has evoked increased research interest (Björk and Magnusson, 2009), as it plays a significant role in the creation of innovations (Koen et al., 2002). On the one hand, FEI has been considered as the most difficult part of the innovation process to manage (Kim and Wilemon, 2002) because it involves a significant amount of uncertainty (Chang et al., 2007). On the other hand, decisions made at this stage will have a significant impact on subsequent phases of the innovation process (Apilo and Taskinen, 2006).

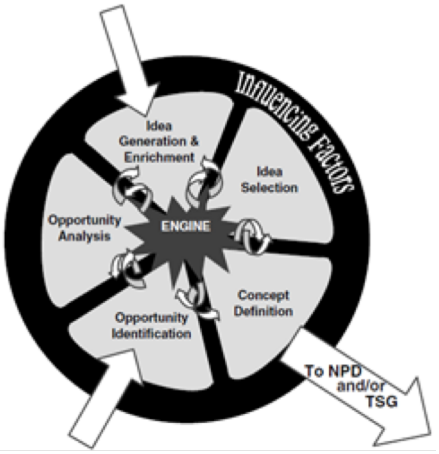

Fig. 2. Front end innovation for developing a new product concept (Koen et al., 2001).

Fig. 2 presents tasks included in FEI from the point of view of developing a new product concept. The process begins either with a recognized possibility/problem or a new idea (Koen et al., 2001) and ends in the decision to launch or not to launch an actual development project (Kim and Wilemon, 2002). In a FEI process, one essential part, is in fact, idea refining (Griffith-Hemans and Grover, 2006). Miller et al. (2006) emphasize the importance of refinement especially in the creation of radical innovations. Then again, the best innovations are not usually born from one idea but from the combination of different and multiple seeds of ideas (Apilo, 2010). The ability to combine ideas is, in fact, essential for good innovators (Dyer et al., 2011). In FEI, it is normal to make several go/kill decisions where the continuation of ideas is decided (Cooper, 2008). The evaluation of the ideas and decision-making can be supported by tools that include different evaluation criteria (Paasi et al., 2007). Especially at the end of FEI, ideas should be evaluated from multiple different perspectives, e.g. considering technological feasibility, user experiences and potential business revenues (Khurana

and Rosenthal, 1998). An innovation process performed once is not usually sufficient in FEI, but the process must be iteratively repeated several times before a great idea is found (Sandmeier et al., 2004; Sims, 2011).

2.2 Collaboration

For innovation creation, the active engagement of network partners in collaboration is needed (Miles, 2000) since in this way the different experiences, knowledge and know-how of different people can be combined (Fay et al., 2006). Networking and interaction between people can collaboratively create ideas, which individual persons are not capable of creating by themselves (Wiseman and McKeown, 2010). In this regard, heterogeneous groups have been seen as an important success factor, especially for the creation of radical innovations (Dyer, 2011; Sims, 2011). Innovation research should, therefore, concentrate especially on network-level studies (Apilo, 2010), as networks possess considerable innovation potential (Crevani et al., 2011).

2.3 Success factors for radical innovations

Literature recognizes a wide array of success factors for incremental innovation (e.g. Filippini et al., 2004; Carbonell and Rodriguez, 2006). The success factors of radical innovations, however, have received less attention (Kach et al., 2012). This is a significant deficiency since the characteristics of radical and incremental innovations differ considerably (McDermott and O'Connor, 2002). Thus, the success factors will most probably differ, as well (Kach et al., 2012). For example, radical innovations usually include greater uncertainties and risks than incremental innovations (Calantone et al., 2006), and especially FEI is complex and involves multiple uncertainties (Vandenbosch and Clift, 2002). In addition, the high level of uncertainty and risks usually means that the utilization of formal methods to facilitate the innovation process is challenging (Li and Atuahene-Gima, 1999). McDermott and Handfield (2000) mention that the acceleration of innovation may e.g. weaken the originality of the outcomes. Instead of strict formalization, more flexibility is needed, e.g. in regard of given schedules (Chiesa et al., 2009). According to Kessler and Bierly (2002), the acceleration of the innovation process might fit into the realm of incremental innovation projects, but not that well into the area of radical innovations.

2.4 Time pressure in radical innovations context

Several studies do examine the acceleration of development (e.g. Kessler and Chakrabarti, 1996; Chen et al., 2010), but there is no comprehensive research on the effect of time pressure in the context of radical innovations. However, at least Kach et al. (2012) have studied the phenomenon and found different variables which explain the effect of time pressure on radical innovation. The variables are divided into three groups: antecedent, intervening and outcome variables. The theoretical framework they have built has been presented in Fig. 3.

According to the research by Kach et al. (2012), visionary leadership, maintaining project momentum, and team collaboration have an essential impact on the success of a radical innovation project. The leader helps to ensure the clarity and direction of the project and secures the commitment of people to the project. The project focus is

maintained, as well as the creative and result generation. Through team collaboration, the members are ready to invest extra effort in order to achieve the goals in the desired schedule.

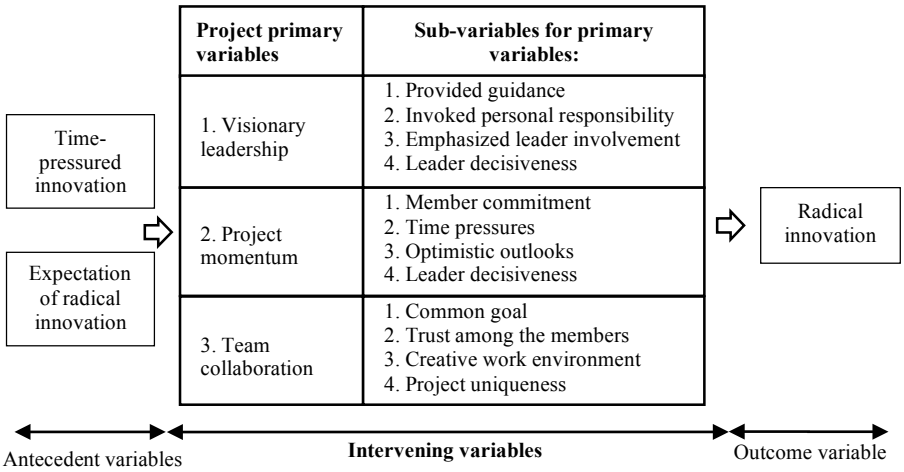

Fig. 3. Framework for time-pressured innovation in its development phase (Kach et al., 2012).

The research by Kach et al. (2012) focuses mainly on the *development phase* of the innovation process. In this article, the framework they have created for the development phase is applied to the *FEI phase* – in other words, an earlier phase of the innovation process. In the study by Kach et al. (2012), the miniature airplane had already been chosen for development, whereas in our research the target of the innovation process is to create a broad variety of different and new ideas about digital jewelry, where only one will be chosen for further development. The difference between these two research scopes is illustrated in Fig 4.

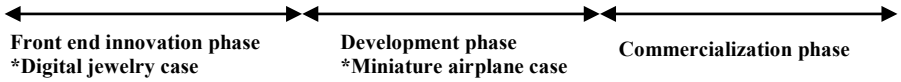

Fig. 4. Differences of the case studies, based on the phase of the innovation process

Both these studies do focus on radical innovations, implemented collaboratively under a time pressure. Related to Fig 4, it is also important to note that the acceleration of the innovation process is also possible with radical innovations, but it is not clear how far the acceleration can be applied without problems. The illustration does present a distinct point between FEI and the development phase, but in reality the changeover point might not be that clear. This fuzziness of the change point can make the decision of when and where to apply time pressure and acceleration quite difficult. To facilitate these decisions, the effects of time pressure and people's acceleration-related stress levels in the work groups should be known by the team leaders.

2.5 Theory of the effect of stress related to productivity and outcomes

Stress as a term is highly subjective, which means in principle that the term defies

definition. Nevertheless, e.g. Selye (1936) defined stress as "*the non-specific response of the body to any demand for change*", showing with numerous laboratory animal experiments that by subjecting them to acute but different noxious physical and emotional stimuli (e.g. extreme noise levels) all test subjects exhibited the same sort of pathologic changes indicating higher stress levels. From the research point of view, in this time-pressured FEI study, it was important to understand how time pressure stress impacts people participating in a time-pressured FEI process. For example, could a certain amount of stress applied into the innovation process be advantageous in terms of the outcomes, without harmful side-effects, as e.g. Selye was already suggested in 1936?

Stress is typically seen only in a negative light; some older dictionaries even define stress as "*a condition or feeling experienced when a person perceives that demands exceed the personal and social resources the individual is able to mobilize*". This negativity overweighs the possible positive side-effects stress might have. Luckily we currently know that stress can enhance performance, and it can motivate people to accomplish more than otherwise would be possible. These positive sides of stress are reflected e.g. in the research of Nixon (1979), with a model relating performance to stress arousal levels. The model presents a certain comfort zone and a zone above the comfort area where added stress continues to assist performance without generating adverse effects, as show in Fig. 5.

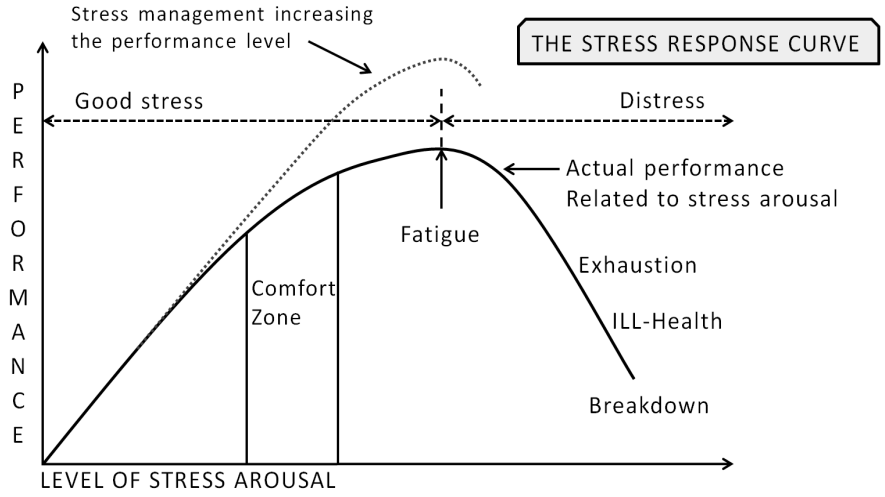

Fig. 5. Relationship between the level of stress and performance depicted in the form of an inverted U-curve. Based on the work of Nixon (1979), illustrating the effect of stress management methods on performance.

What makes the relationship between stress and performance so interesting, especially in FEI and the time pressure context, is the research work following Nixon (1979), relating stress properties to human reactions to it. For example, according to Tache and Selye (1985), nervous and hormonal responses to stressors aid the survival of an individual. It was believed that the demand-induced neuro-hormonal changes in the body are carefully balanced to enhance the organism's capacity to meet challenges. Consequently, the neuro-hormonal changes would also be adaptive, which is in line of

basic assumption that only part of a person's behavior is written in genes and the rest is dictated by our actions and by the environment. Considering high stress levels and the breakdown point, Nixon's (1979) model suggests extreme end results for extreme amounts of stress. Related to that, Simonton et al. (1978) and Goodkin et al. (1986) have suggested a direct connection between stress and e.g. cancer and heart disease (Matthews and Glass 1981).

In this study, the stress in the FEI process is directly related to the level of uncertainty felt by the participants towards the feasibility of a task in a given time. Time pressure was not believed to be the explanation to the stress level. In fact, the explanation was believed to be the level of uncertainty related to the time and task given to the participant. This interconnection of stress and uncertainty relates to the way McEwen and Stellar (1993) model biology and behavior. Responses that are stressful result from the interpretation of, and behavioral and physiologic responses to the environmental challenges. They state that a challenge may be stressful to some and less or not stressful at all for others. Also based on the work of Gunnar and Quevedo (2007), in general, some people succumb and others thrive when they are confronted with similar challenges.

The above-mentioned challenges change the "rules of the game", which consequently changes the quality of life and conditions surrounding a person. In situations like these, McEwen and Wingfeld (2003) state that people undergo physiological changes as a response to the challenges. These changes are an attempt to restore the optimal state, e.g. through a launch of immune responses. In a low frequency, these changes are not dangerous or harmful, but in dramatic loads and attempts to achieve stability, an overload is possible, which may result (McEwen and Wingfeld, 2003) e.g. in the development of mental and physical illnesses through effects on the body and brain.

This study expected to witness people starting to manage their stressful events, increasing their performance level as shown in the adapted model of Nixon (1979) in Fig. 5 (better performance through stress management). By applying stress management methods to repeated stressful events, participants should start to perform better when the study continues. This is of course assumed to happen only if the stress is not related to well-known, deeply ingrained personal habits, which are difficult to change (e.g. Adams, 2003). Similarly, a higher tolerance to stress might develop e.g. if a person is under significant stress due to an outside output or requirement without the tools and means to manage the stress. With guidance, education and mentoring from outside, the person can learn to manage the particular requirements. With help, the stressful situation is changed into a more commonplace requirement, which makes it easier to cope with. As a practical example, when a person is learning to drive, public roads may be a very stressful environment. Later on, when the driving process becomes more familiar, driving itself will become less and less stressful. Through this learning process, the driver can focus more on the quality of driving, and his or her performance on public roads is improved.

3 Planning the research

The first aim of the research was to identify the advantages and disadvantages of time

pressure in collaborative and radical FEI. The second aim was to evaluate the fit of the theoretical framework of Kach et al. (2012) in the FEI context, which precedes the development phase for which the framework was originally developed. As third aim of the research, was to research the balance between added stress and time pressure and the relative productivity and creativity of the participants. This is then reflected with the theoretical context of stress related research, to support the main aim of the research.

The research was performed as a case study of one FEI project, where the success of the project was measured on the Likert scale from a quantitative and qualitative (radicality of ideas) viewpoint with the following questions:

- How radical is the best concept created in the project? Radicality was defined based on the importance of problems the concept could solve.
- Aside from the winning concept, were some non-winning ideas or concepts discarded too early during the FEI process?
- Number and radicality of rough ideas.
- Number and radicality of conceptualized ideas.

The above-mentioned questions were answered by the four members of the project team months after the project had ended, at which point some distance had been attained to the project. The respondents played different roles in the project: one was a visionary leader, one an operative and artistic leader, and two were idea creators, idea refiners and experts.

Furthermore, these persons also qualitatively evaluated how they experienced the progress of the project. This evaluation took place from the viewpoint of the intervening variables presented in Fig. 3. The research data was created with the self-documentation method, i.e. all four persons wrote down their own views of each intervening variable independently of each other. Self-documentation is one sub-method of interviews (Hyysalo, 2006). The self-documentation form is presented in Appendix 1.

The implementation and outcome of the project were also evaluated by an outside evaluation group: an industrial steering group. The group's task was to ponder how the implementation and outcome of the project could have been improved. The evaluation group was composed of altogether 12 persons, whose task was to provide qualitative answers to two questions:

- What would you have done differently?
- What question did the implementation and outcome of the project especially invoke?

In the data analysis, the most recurrent similarities and greatest differences in the answers of the four respondents were identified and examined. In the case of divergent views, reasons behind the different views were evaluated by interviewing the participants. After this, the cause and effect relationships of the intervening and outcome variables were examined, i.e. which intervening variables especially affected the outcome variable, i.e. the radicality of the project's output. Finally, the views of the innovation group and the industrial steering group were compared. The presented research results are the advantages and disadvantages created as a result of time pressure in a collaborative FEI, taking into consideration the stress level experienced during the project. In addition, the research results assess the suitability of the theoretical framework of Kach et al. (2012) for the FEI process.

4 Description of the innovation project

In this approximately three-week long project, the innovators were industrial representatives (especially form the jewelry industry), researchers, academics from universities and students in polytechnics. The participants came from six different departments/knowledge areas: the jewelry industry, business, industrial management, ICT, mechanical engineering, and art. Thus, the innovation group members had very different backgrounds and areas of know-how. The age range was between 20 and 45 years. The outcome (concept) evaluator was a serial entrepreneur, who had no ties to any of the participants or their organizations. Fig. 6 presents the innovation group and its most important interaction relationships.

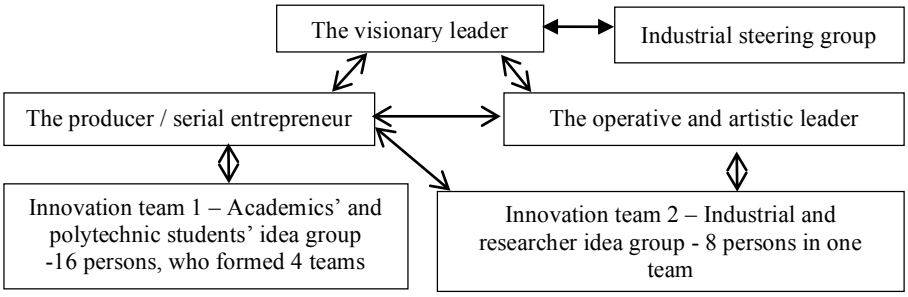

Fig. 6. The innovation group and its most important interaction relationships.

The visionary leader gathered and organized the project group, set the goal and schedules for its activities, and gave a briefing (shown in Fig. 7).

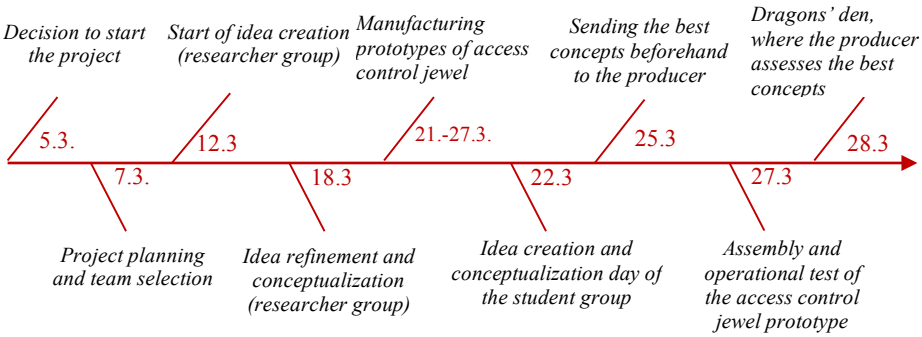

Fig. 7. Schedule and main events of the FEI project.

The goal was to create 5 to 10 quality ideas for the dragons' den, where ideas suitable for further development and commercialization would be chosen. The visionary leader did not participate much in daily operations, which were run by the operative leader, according the guidelines given by the visionary leader. The idea creation and conceptualization by the innovation team 1 was quite intensive, as it only last a day. The idea creation and conceptualization of innovation team 2 consisting of industrial representatives and researchers was carried out over approximately a two-week period.

As a whole, the innovation team 2 spent approximately twice as much effective working time on creating ideas than the innovation team 1.

During the project, the innovation teams 1 and 2 created altogether 203 rough digital jewelry ideas. A total of 27 conceptualized ideas were created and 23 concepts were delivered to a producer prior to the dragons' den. The serial entrepreneur (dragon) chose five concepts for the dragons' den. Four of them came from the innovation team 1 and one from the team 2. The ideas that proceeded to the final stages were: mosquito/tick repellent jewel, access control jewel, sleep jewel, baby monitor jewel, and a flower stick indicating the need to water a plant. On the basis of business potential, feasibility, and the user viewpoint, the producer finally chose the access control jewel as the best concept. Fig. 8 presents the idea creation process as a funnel image from the perspective of selecting the most feasible ideas and concepts and making go/kill decisions of ideas and concepts.

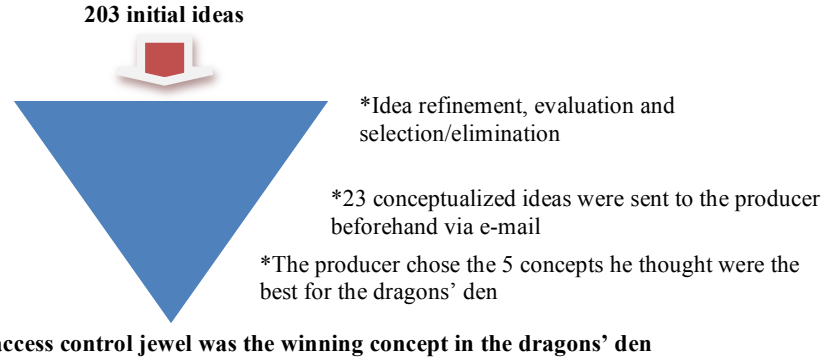

Fig. 8. Idea funnel of the innovation project.

Fig. 9 illustrates the winning concept, the access control jewel. From the left: a 3D model, quick prototype, and operational test. The frame of the prototype was made with a 3D plastic printer. A RFID tag was placed between the frame and jewel stone.

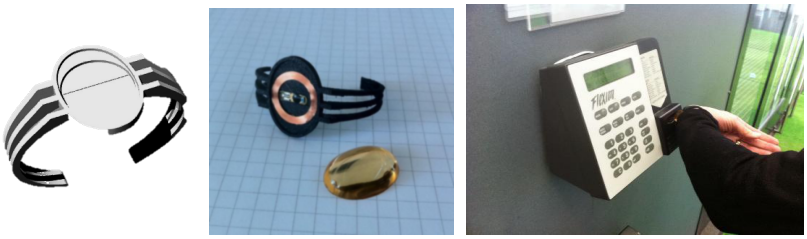

Fig. 9. 3D model, quick prototype and operational testing of the access control bracelet.

In addition to a bracelet, quick prototypes were also made of a ring and a tiepin. In the dragons' den, the serial entrepreneur stated that a killer solution would have been an access control wedding/engagement ring. The prototype tag would have been too large for the ring, but smaller tags are already available at the market. A weak market test was later conducted for this idea by presenting it to a lead designer of a jewelry factory, who saw potential in the idea. In fact, the designer started to develop new vision of the

concept for busy people with a difficult smoking habit.

5 Analysis and results of the innovation project

This section presents the analysis and results of the studied innovation project. The first subsection examines the outcome variables and the second subsection examines the intervening variables from the viewpoint of the FEI project participants. In the third subsection, the innovation project is evaluated based on the feedback provided by the industrial evaluation group.

5.1 Outcome variables – Quantity and quality of the created ideas and concepts

The four participants in the project were asked to answer five questions on the Likert scale (Appendix 1), measuring the success of the project. The answers are presented in Table 1.

Table 1. Evaluations of the quality and quantity of the created ideas and concepts.

Indicator	***Visionary leader***	***Operative leader***	***Idea creator 1***	***Idea creator 2***
Radicality of the winning concept	3	3	2	3
Possibility for an outcome more radical than the winning concept	4	5	4	4
Number of initial ideas	4	4	3	3
Radicality of initial ideas	2	2	2	2
Number of conceptualized ideas	5	4	4	4
Radicality of conceptualized ideas	3	3	3	3

The participants of the innovation project largely agreed on the results of the project. With regard to radicality, the winning access control jewel concept was considered satisfactory. Everyone believed that it would have been possible to create a more radical outcome based on other ideas or a combination of them. The number of rough ideas was considered high, given the time to innovate. The radicality of the initial ideas, on the other hand, remained at a tolerable level. The quantity of conceptualized ideas and their radicality was considered satisfactory. It is noteworthy that the radicality of rough ideas and conceptualized ideas was seen as tolerable and satisfactory, but it was believed that good or even excellent concepts could be derived from them. In practice, this means that the participants thought that the initial ideas could have been improved, but this would have necessitated further refinement of the ideas as well as combining different ideas.

5.2 Intervening variable inspection

Next, views on the course of the project of the visionary leader, the operative leader, and the two idea creators who participated in the FEI project are presented with regard to the three key variables as well as their sub-variables (framework in Fig. 3). The most similar and divergent views of the group have been highlighted. After the examination

of the three key variables, Tables 2-4 present direct quotes from the participants regarding the different sub-variables.

Primary variable - Visionary leadership. *Sub-variable 1. Guidance – providing clear project understanding*. The visionary leader issued clear goals, instructions, duties, and checkpoints, which held the project together. The outside serial entrepreneur was also committed and given a role in the project by the visionary leader. The operative leader became a part of the project in a somewhat surprising manner. The visionary leader asked the innovation team 2 who would be willing to take on the role of an operative leader. The newest member of the team was the most enthusiastic. One goal of the project was to make prototypes of an earlier idea, the access control jewel. Later it became apparent that this choice was both an advantage and a disadvantage. The advantage was that the concreteness motivated people – "*Hey, this works!"* The disadvantage was that the access control jewel rose to a privileged position compared to the other ideas. Then again, the prototypes could also make it more difficult to receive follow-up ideas, as the idea was considered to be "finished". The level of description of the ideas varied significantly between the idea creators, so more instructions would have been needed for this. The visionary leader gave the operative leader the final go/kill decision for the idea. Retrospectively, more joint discussions would have been needed inside the group in decision-making situations. Furthermore, in the project's checkpoints the evaluation of ideas easily focused more on feasible rather than radical ideas. The visionary leader should have emphasized the pursuit of radical ideas from the very beginning.

*Sub-variable 2. Responsibility – taking personal ownership***.** Both the visionary leader and the operative leader were very committed to the project. Without their complete commitment the project goals would not have been reached. This inspired some other group members to strive towards the same. However, all participants did not comprehend what the leader was after, which caused frustration and, therefore, a varying level of participation and ideas. Furthermore, not everyone considered the theme of digital jewelry as sufficiently inspiring.

Sub-variable 3. Leader decisiveness – to provide direction, not to control. The direction, goal and schedule had been provided, but in other regards the idea creators were free to work as they wished. In the end, there was relatively little communication between the team members although the operative leader encouraged it. For some, the use of e-mail in refining ideas was problematic. Not everyone produced the requested amount of rough ideas. This revealed that not everyone was wholly committed to the project. Then again, 85% of the persons produced the requested number of rough ideas and participated actively in the refinement of ideas and conceptualization. There were more commitment problems in the innovation team 2. The amount of work necessitated by the project also came as a surprise to some. From the start, everyone should have been asked personally whether they could fully participate in the project and how enthusiastic they were. The operative leader was very decisive in considering idea viability and making the go/kill decisions. Too decisive, according to some, as the rest did not have enough say in the matter. This may have weakened the motivation of the rest of the group and distorted the end result.

Table 2. Quotes related to visionary leadership.

Sub-variables	Quotes
Provided guidance	*-I Tried to keep things as clear and simple as possible because of the tight schedule -Without hesitation I immediately announced my willingness to take on the role of operative leader.* *-Unprejudiced attitude and encouraging instructions of the visionary leader convinced me that the project would succeed.* *-At most 75% of the decisions should have been made by the operative leader and at minimum 25% by others.*
Invoked personal responsibility	*-I wanted this to work.* *-As an operative leader, I was very committed and highly motivated. I was active as I desired to prove to the prejudiced team that an artist is not just a bohemian walking around with a beret on his head.*
Leader decisiveness	*-I didn't have to interfere in matters much since mainly everything worked smoothly. My only concern was that the group didn't work together enough.* *-In retrospect, the project flow would probably have been considerably better if a common spirit would have been achieved through meetings.*
Emphasized leader involvement	*-After the initial instructions, I gave the operative leader free reins. I helped a couple of times after being asked to.* *-Between the work stages there should be a time during which there would be no communication messing up the process.* *-Couldn't stay away from idea creation once a reasonable idea had been created.* *-In order to achieve the planned goals, I had to do a lot myself. Activating less-motivated members would probably have taken up precious time.*

Sub-variable 4. Leader involvement – hands-off but attuned. The operative leader participated closely in the operations, as was the purpose. At the same time, the leader let the group work in peace and did not interfere in their activities. However, the operative leader carried too much responsibility especially regarding the refinement of ideas and conceptualization. The others were free to work in peace partly due to the fact that the operative leader carried out other people's work, as well. Some would have wanted to know the deadlines in more detail, meaning that the timetable provided in the beginning was not clear to everyone. The visionary leader supported the operative leader when the rest of the team did not provide the necessary input. Furthermore, the visionary leader participated a little in the idea creation. One idea of the visionary leader was refined the most enthusiastically by the group – it is unclear whether this was due to the quality of the idea, the way it was presented, or the leader's surprising participation in the team work.

Primary variable 2 – Project momentum. *Sub-variable 1. Member commitment – to an important and rare opportunity.* The innovation of digital jewelry was an interesting new subject for many, as was the possibility to have ideas assessed by a serial entrepreneur. However, there were quite remarkable differences in the commitment of the group members – especially in the innovation team 2. It is important to find people who are genuinely enthusiastic and have time for the project. This has to be made clear

already before the project begins. Then again, beforehand the work started, the work time loads did seem to be favourable with almost everyone.

Table 3. Quotes related to project momentum.

Sub-variables	Quotes
Member commitment	*-Surely it wasn't nice for those who, due to a lack of time, couldn't carry out the agreed tasks in full.* *-The committed participants were fully involved.* *-For some, the anticipated and realized working time resources didn't match at all.* *-Considering the starting point, the commitment and outcome were at a surprisingly high level.*
Time pressures	*-We did get the job done, but at the expense of the quality of the ideas.* *-Could we have utilized something in idea creation that would've guided our thoughts to new paths?* *-Working together towards a common goal would have been necessary to reach better results.* *-There was pressure to focus more on quantity than quality and that was seen in the outcome.* *-Group meetings would have been needed, but we couldn't find the time.*
Optimistic outlooks	*-The project didn't feel like work as it was so different from the rest of the typical duties during a working day.* *-Although we were busy, no one complained much. Having to work in the evenings as well as the operative leader's too big role in decision-making caused some grumbling.* *-Participants with a positive attitude helped to cope with the trouble of dealing with those who lacked commitment.*
Leader decisiveness	*-There wasn't even time to ponder irrelevant matters; we just had to go for it.* *-Somehow we could sense it from the very beginning, that this could be done.*

Sub-variable 2. Time pressures – limited time as an asset. Time pressure was an asset in that the members did not get stuck on trivial matters. They pushed forward and were inspired by the achieved intermediate results. Then again, especially at the stage of refining and combining ideas the schedule was too tight, as a result of which some members had to work during evenings and weekends as well. This surely influenced their energy levels and, eventually, also the quality of the ideas and concepts. At that stage, it was seen that the stress became excessive, affecting the results and also some follow up work too. In the end, the busy schedule probably prevented the creation of any truly great idea. In addition, the members would have wanted methods or tools to promote the creation of ideas. In practice, the participants were not provided any, which may have been a crucial mistake. They would have been useful especially in the joint sessions. Due to the high time pressure, working together was generally insufficient, participants pursued the goal set and when they achieved it, a new goal was already

given. With regard to the outcome, there seemed to be no considerable difference in the innovation team's one-day-long idea creation and the longer idea creation period of the innovation team 2. The concepts created by the innovation team 2 were, however, slightly better described.

Sub-variable 3. Member outlook – optimistic. The enthusiasm and positive attitude of the committed group enabled the completion of the project. In addition, many saw the dragons' den and meeting with a serial entrepreneur as an important motivator, which further increased their performance.

The optimism of some members was weakened by the lack of time, which led to working during the weekends and evenings as well as unfinished work, and was later on also reflected in the stress level vs. performance analysis.

Sub-variable 4. Leader decisiveness – quick and effective. The leader was very determined, which partially helped to see the challenging process in a more positive light. This motivated most of the others to adhere to the deadlines. It was also noted that in this type of FEI process, it seems to be better to make quick and, at times, poor decisions than not to make any decisions at all.

Primary variable 3 – Team collaboration. *Sub-variable 1. Common goal – Let's achieve great results***.** Regarding the schedule, the goal was clear since a date had initially been set for presenting the created concepts in the dragons' den and for choosing the best concept. What was less clear was what level of ideas and concepts pursued. The visionary leader was not so worried about this – if everyone would do their best, the outcome would be successful and provide a good starting point for FEI. On the other hand, the pursuit of radical ideas should have been emphasized more. In addition to digital jewelry, some other ideas were created. However, they were somehow mainly related to ornaments. When making prototypes for the access control jewel was added to the goal, this motivated some group members – especially as it was known that this would require working together. All in all, the goal was challenging but still realistic. The visionary and the artistic leader boosted faith in the project with their own behavior.

Sub-variable 2. Trust – there is no time not to trust one another. The project proceeded smoothly without greater friction between the participants. It was generally easy to present and comment on ideas; the atmosphere was relaxed. The members of the innovation teams already knew each other, which had an impact on the matter. Then again, especially the team 2 had not worked together extensively, and the operative leader was a complete stranger to many. Trust was established between the visionary and the operative leader immediately during the first meeting. However, the operative leader experienced a lack of trust from some group members. This may have been the reason why these members were indifferent towards the checkpoints and requests for urgency. Also the fact that the people were busy had an impact on the matter, as was previously mentioned. The lack of face-to-face group meetings during the first half of the project in part weakened the building of trust. Ideas and concept descriptions delivered late meant rush work for the operative leader at the end of the project. Still, the leader managed to keep to the schedule. Thus, if not even earlier, by this point the operative leader had managed to earn the members' trust. During the final meeting with the serial entrepreneur, the whole group had a very open discussion.

Sub-variable 3. Work environment – beyond the call of duty. As a whole, the work

atmosphere was good. This was facilitated by the fact that the goal and the roles of the group members were quite clear. Some were bothered by the fact that they could not participate in a way necessitated by their role. For some, it was not convenient or even possible to work during evenings and weekends, which was at times called for. On the other hand, the matter can be reversed, i.e. if the members wanted to invest in the matter during evenings and weekends, they found the project very interesting. The operative leader was bothered by the indifference of some members regarding schedules and the quality of ideas. On the other hand, operative leader was a new member in the team and as such did not have as many other responsibilities as the other participants did, which might have made the operative leader incapable of making this evaluation objectively.

Sub-variable 4. Project uniqueness – one of a kind. The project was a unique experience to nearly everyone. For many, the exceptional speed, challenging goal, and working together in a group were as important or even more important than the actual target of innovation, i.e. digital jewelry. The icing on the cake was the presence of the serial entrepreneur. In fact, after the project many members said that they had never been involved in something like this before.

Table 4. Quotes related to team collaboration

Sub-variables	**Quotes**
Common goal	*-At first, the whole sprint seemed extremely challenging, almost impossible for some. Especially making the prototypes generated more challenges.* *-Some seemed to be a bit lost regarding the level of ideas sought for.*
Trust among the members	*-Trust was created also with the producer, and assessing the ideas with the producer was one of the best experiences in the different projects.* *-It felt like many members didn't take me seriously. Perhaps this was because I'm a strange guy with long hair and, on top of everything else, an artist.*
Creative work environment	*-Completing the project was fun and interesting, which boosted performance.* *-Among those committed to the project, the atmosphere was good, but at least I was annoyed that some people didn't respect the schedules.* *-Testing idea with an outside producer did challenged many to over-perform.*
Project uniqueness	*-As success factors, the uniqueness of the project was, alongside a beforehand created framework, the most important key to success.* *-The uniqueness of the project could be noticed from the fact that most of my free time was spent on this project.* *-A very educational, interesting, and unique experience.* *-The icing on the cake: a good and refreshing exception to everyday routines.*

Summary of the intervening variable analysis. With regard to all three primary variables, visionary leadership, project momentum, and team collaboration, things could have been done better. However, better leadership could have reduced problems in project momentum and team collaboration. But then again, three weeks was a very short time. Things were a little confusing right from the start as the visionary leader who started the sprint handed the responsibility over to the operative leader.

In the studied FEI project, time pressure was a double-edged sword. On one hand, it

created exceptional movement and experiences of success in the innovation group. It had to be proven that viable ideas can be created in a short time. On the other hand, the outcome, i.e. the access control jewel chosen as the best concept, was considered merely as a satisfactory concept. However, the number of rough ideas was considered good, which supports the view of the Nobel laureate Linus Pauling, according to whom the best way to achieve good ideas is to create a lot of ideas (Dyer et al., 2012). Thus, the possibility to create great new ideas by combining ideas already generated grows exponentially. Nevertheless, in the studied project, ideas were not refined and combined enough, as a result of which the concepts were largely created merely by describing the initial ideas in more detail. In fact, the added stress level and lack of time in the middle and later parts of the project seemed to prevent working on and combining the ideas further, which consequently seemed to have a negative impact on the outcome of the project. Therefore, the time pressure might have a negative impact on the results if the process is not facilitated to allow or force participants to combine ideas. Perhaps the set timelines also directed too much attention to the number of ideas and on the deadlines instead of the refinement of ideas, leading the members to be satisfied simply with keeping to the schedules and meeting the numeric goal of ideas. The analysis of the project revealed that when planning the project, some participants overestimated the time they could actually spend on the project. This is quite a typical problem in a matrix organization (Dyer et al., 2011). Secondly, the leadership of the innovation project was not able to anticipate and sufficiently communicate how much working time the project would require. As for future research, the effects of the right leadership methods on radical innovation productivity in FEI should be studied more. For example, time pressure in FEI with operative leadership that push very hard to pursue a goal of high idea amount, but then realizing the importance of mentoring to use different tools to combine and add idea radicality. In short, the ways to make ideas better is more important goal to learn than to just purcue towards added amount of ideas.. According to Rehn (2012) a large number of ideas is necessary, but leadership approaches must be carefully thought through to be able to support people in pushing themselves to generate a large number of ideas.

However, a lack of time in itself does not explain the satisfactory level of the outcome. One clear reason for this was that the members strived to improve the ideas largely via e-mail. Only one joint face-to-face idea creation meeting was arranged prior to the meeting with the serial entrepreneur. Because of these working models, different people, ideas and thoughts did not meet very much at all. Rather, individual ideas were further refined during FEI. Genuinely enthusiastic interaction occurred only a few times between the group members. In addition, the persons who were not fully committed to the project had a negative impact on others. It would have been better to exclude them from the project altogether. Another important reason for the unsatisfactory outcome was the lack of methods offered to participants to support the innovation process. Refining and combining ideas was managed by dialogue, which alone does not seem to be enough – especially as the discussion was usually only directed at one idea at a time. Furthermore, creative work in general was unfamiliar to some. The third reason seemed to be as simple as the fact that some group members were used to work alone and not in a group. In practice, this could be seen in that they did not listen to each other enough and in this way raise the discussion to new levels. To remedy this, the previously mentioned support methods for innovation would be beneficial. In addition,

a transparent idea evaluation template was missing altogether. The power of decision was in the hands of few and the grounds for the decisions were not sufficiently visible apart from the dragons' den. The decisions were largely based on favoring ideas that were feasible with current skills, which ate away at the radicality level; ideas were selected more based on their feasibility than their superiority, without even considering possible challenges in implementation.

Was the three-week-long project too short for the creation of a radical digital jewelry concept? Answering this question unambiguously is difficult. Firstly, without the views of actual clients the FEI group cannot say whether the access control jewel concept has great business potential or not. A weak market test was later on conducted by presenting the idea to a lead designer of a jewelry company, who saw potential in it. From the point of view of many people who wear jewelry the concept does seem to be very radical. This became apparent later when potential customers were asked about their viewpoints. Thus, the next question is whether there would be demand for access control jewels or not. This can only be known if the concept is commercialized and sales begin. The project group believed that the initial ideas could have been made into a more radical concept but, in this case, it would have required more and different kinds of idea refinement and combination work. This would also have necessitated more time, but first and foremost, a wider range of working and decision-making methods. In addition to time and working methods, also people from completely different cultures and education backgrounds could have been selected to be part of the FEI project to support positive idea collisions.

On the other hand, satisfactory results were gained in a very short time. With results like these, it might be just the right time to test a mediocre concept (of which the prototypes already exist) in the field. For example, Sims (2011), Sarasvathy (2008) and Leppänen (2013) all think that even mediocre concepts are worth testing in the field. Field testing provides valuable feedback, and even if the tested idea does not work, it still may lead to completely new ideas. Activities like these are natural for entrepreneurial behavior, i.e. effectuation (Sarasvathy, 2008). From this perspective, time-pressured innovation worked well. And as motion and iteration are important in innovation (Sims, 2011; Sarasvathy, 2008; Sandmeier et al., 2004), there is nothing preventing the refinement of the created rough ideas or combining them with new ones.

Finally, learning from the implemented innovation project is important. The following time the group will be better prepared for planning, leading and implementing a project, but does this mean that the outcome will be better? What happens if the composition of the group is modified, changing the range of know-how available? What if the decision-making criteria and the decision-makers are changed? Merely one extra joint session lasting a couple of hours could improve the outcome considerably. At this point, these matters can only be speculated on since there are plenty of variables in human-centered systems. Without a doubt, there is room for research in this area also in the future.

5.3 Feedback from the outside evaluation group regarding the innovation project

A total of 12 persons from different companies participated in the project's evaluation group. The visionary leader of the innovation project presented the progress of the project in stages as well as the intermediate results and the outcome to the group. Based on this data, the evaluation group recorded their own views on two questions: what they

would have done differently and what question the project especially invoked. The group members' views are presented in Table 5.

Table 5. Views of the evaluation group regarding the idea creation project.

Respondent	What would you have done differently?	What question came up especially in the project?
1	-Creating ideas together from the start -Weekend work is not a good idea	-The novelty value and unexpectedness of the winning idea were weak. On what basis was the best idea chosen?
2	-Idea creation could be realized internationally by using dispersed teams and digital support tools -Ideas should have been combined more – taking the best parts of different ideas and iteration	-Reverse definition could be tried. For instance, what kind of a jewel could be created with the production costs of X euros?
3	-Would've left out the weekend work	-What are the tools for inspiring people from different organizations to genuinely create ideas together?
4	-Prototyping emphasized one idea, i.e. the ideas had different values	-On what basis were the ideas eliminated? Feasible, new idea, impossible…?
5	-A more extensive decision-making forum -Reversing the decision-making criteria -Iteration of ideas, i.e. starting from scratch every now and then	-A completely new viewpoint for idea creation is needed in order to achieve different kinds of ideas -When the starting point is a digital jewel, then two matters are glued together and nothing new is created
6	-The idea creation group should spend a week 'in a cave' 24/7	-Would be worth including engineers and designers in the idea creation
7	-The producer should have been more involved in the process	-
8	-There should've been more rough ideas. Crazy ideas only arise when we run out of easy ones -First finding a good idea and only then the design and technical execution. A prototype is not an end in itself	-Was the funnel too narrow and decision-making in the hands of too few? For example, voting, preventing the promotion of one's own idea. -Was the team really multidisciplinary or did they share the same viewpoint?
9	-In the ideas, services and processes should maybe be pondered more. Too much focus on product ideas.	-
10	-Idea creation outside the familiar group – e.g. on Facebook	-
11	-Prototypes from more ideas -Is the view of producer sufficient?	-How was the project experienced by the different parties?
12	-	-How had the task originally been briefed? Ideas were quite one-sided – idea creation of a technical product

The views of the evaluation group corresponded largely with the views of the other project group. The most significant new issues that came up were the utilization of a more multidisciplinary and international idea creation group in the creation of ideas, moving away from product-centered thinking, as well as making the serial entrepreneur

a more active participant.

5.4 Time pressure as a source of stress in the innovation project

Based on the comments of the participants, it seems that for the innovation team 1, the performance and stress levels were mostly higher than in the innovation team 2. On the other hand, it is well known that in this case the innovation team 1 had a clearly defined time period to work on the project, which may naturally improve both the focus and time pressure and also the end results.

From the innovation team 2, e.g. the following comments were recorded: *"Felt like many members didn't take me seriously. Perhaps this was because I'm a strange guy with long hair, and on top of everything else, an artist."* It does seem to indicate that some of the participants did not feel too much pressure or stress during the process and considered results making as optional option. They seemed to produce results only when they felt inclined to do so. As such it would indicate a stress level within the comfort zone.

In contrast, the following comments indicated high pressure:

- "*There wasn't time to ponder irrelevant matters; we just had to go for it.*"
- "*There was pressure to focus more on quantity than quality and that was seen in the outcome.*"
- "*We did get the job done, but at the expense of the quality of the ideas.*"

These comments also link to each other and those are in line with the other findings of this study. For instance, some people considered the time pressure related stress to exceed their tolerance level, and what they produced was quantity, not quality. After the dragons' den, some people speculated that because of the time pressure, they tended to generate ideas mostly from their areas of specialization, pointing out that to meet the schedules, they did not challenge themselves, but in fact kept working in their comfort zone.

Examining the comments and the results of the research and group, it seems that the operative leader was the only person to truly challenge and push the group in a sufficient manner. The operative leader stated: *"Among those committed to the project, the atmosphere was good, but at least I was annoyed that some people didn't respect the schedules."* This shows a clear frustration towards the team, as the level of participation was not as high as what the leader personally considered having invested in the project. The stress levels vs. performance of participants are illustrated in Fig. 10.

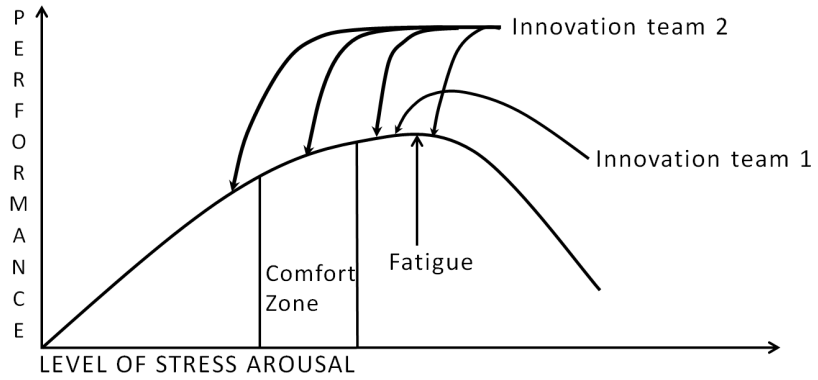

Fig. 10. Stress level of different participants in the innovation project.

The leader commented on the stress levels and the FEI process as follows: "As the role of operative leader and the implementer of applying of technology into the jewelry apple to produce medium+ size concepts, I would say that everyone was out of comfort zone. Personally it can be said that I pushed myself really hard. It was especially challenging when most people in the innovation team 2 did not seem to follow the timetables and did not work as guided. Given the time pressure the team 2 did not seem to be able to produce the expected results, so I had to do their part too, and as a result I did not have the time to worry about stress. And finally, if anything, I think the only way to really understand why things happen like they do and how people really react to stress is to do things with them and be part of the real life experimentation".

6 Discussions

This research has expanded on the work of Kach et al. (2012), in which the focus was mainly on the development phase of the innovation process, by testing the applicability of the model in the FEI phase – an earlier phase of the innovation process than the model was originally designed for. Based on the results, the theoretical framework of Kach et al. (2012) for variables that explain the effect of time pressure on radical innovation is extendable to the FEI phase of the radical innovation process in addition to the development phase, for which it was originally intended. Based on the study, the theoretical framework created by Kach et al. (2012) for the development phase of the innovation process works also in the analysis of the FEI process, and as such its extensibility to other parts of the innovation process should be researched more in the future.

From the time perspective, it was found out that a clearly defined and short project makes people focus their thoughts on what is essential. Similar results have also been achieved in the context of the agile development sprint model, named as Scrum. In addition to development sprints, Scrum also includes visioning sprints related to the FEI (Sims, 2011; Goldstein, 2013). On the other hand, Griffith-Hemans and Grover (2006) have stated that in the FEI process, one essential part is idea refinement, and also this study showed that if e.g. time pressure is taken too far, refinement will not

take place in the most productive ways and/or people take short cuts, which will reduce the quality of refinement. In this study, two short cuts were noticed, 1) people did not take enough time to work face-to-face and 2) ideas were not field tested with actual assumed end users. Based on the findings, this research elaborates on the findings made by Griffith-Hemans and Grover (2006).

Considering the perceived quality of the ideas, combinations of different ideas were not explored in the desired way. This could explain the perceived quality of the ideas, as according to Apilo (2010), the best innovations are not usually born from one idea but from the combination of different and multiple seeds of ideas. Also in accordance with the findings of Sandmeier et al. (2004) and Sims (2011), this research indicates that an innovation process performed once is not usually sufficient in FEI, but there is a need to iteratively repeat it several times before great ideas emerge.

Even if the quality of the ideas had not been affected by the time pressure and process acceleration, based on the experiment in this study, the acceleration did not seem to weaken the originality of the outcomes and as such this study does not support statement made by McDermott and Handfield (2000) in that regard. Also as the innovation target was to produce something completely new, research did not find clear support for the claims of Kessler and Bierly (2002), stating that the acceleration of the innovation process might fit into the realm of incremental innovation projects, but not that well into the area of radical innovations.

Considering the time pressure and stress related issues, whatever methods are selected for the FEI process to easy up the stress levels, the feedback and comments by the participants indicated that for some the time related stress was excessive, and that others would have required more cooperation and interaction to improve their performance. All in all, it seems that in innovation projects like these, participants should be taught time and stress management to enhance performance. For this, there should be more facilitated stress with mentoring to the participants how to control the stress. this should be done in a way, which supports and enhances to enhance the performance level, without going overboard in stress and time pressure. This is illustrated simply in Fig. 11.

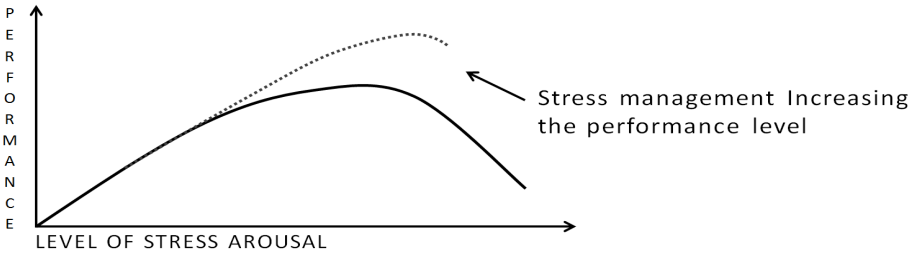

Fig. 11. Simplified illustration of stress management as a method to increase performance level without adding on stress arousal.

Based on this, this research elaborates on the findings of Gunnar and Quevedo (2007) stating that in general, some people succumb and others thrive when they are confronted with similar challenges, as was the case in this study. At the start of the study, it was expected that people would start to manage their time pressure related stress, which would enhance their performance, as modeled by Nixon (1979). Such

findings were made, but not in the way expected. In fact, the participants stated that e.g. *we did get the job done, but at the expense of the quality of the ideas* and *there was pressure to focus more on quantity than quality and that was seen in the outcome*. In other words, people did get better at managing their time pressure, but this was partly at the expense of the experienced quality produced in the process. The research thus expands on Nixon's (1979) model, but not exactly as expected at the start of the research. As for future research, the comments of the participants, e.g. w*orking together towards a common goal would been necessary to reach better results* suggest that Nixon's (1979) model and similar ones could be studied more from the managerial and/or leadership point of view in a time-pressured FEI context. Methodologies applied in the process should be further researched to allow people more efficiently to manage their time in time-pressured situations (e.g. providing help and guidance in how to combine ideas) to produce higher quality, not only high quantities of ideas.

7 Conclusions and need for further study

Based on the study, it became clear that success factors in FEI do not necessarily differ much from the success factors of a development project. Also time-pressured FEI can be successful if visionary leadership, project momentum, and team collaboration are in order, and positive stress is maintained at a level which keeps the group momentum in motion.

This project can be considered as a visioning sprint that provides input for future visioning or development sprints. The time pressure of the studied FEI project had the following advantages: most of the people were committed to the project, an inspiring challenge for a group, people worked together, the focus remained on the goal, concrete results were gained quickly, being open was necessary, and decision-making was fast. On the other hand, time pressure had the following disadvantages: at times decision-making was too fast, it was difficult to organize joint face-to-face meetings, there was not enough time to provide the support and extra guidance needed, there was enough time only to make prototypes of one idea, it was not possible to expand the idea creation group, work had to be carried out also during evenings and weekends, and ideas were not refined and combined sufficiently.

Through the connection with agile development, the studied project is linked with the theories of experimental innovation/learning (Sims, 2011; Kolb, 1984), the principles of which are based on creating new information through experiments. Knowledge is created by going into the field. Field testing, which was largely neglected, should have been conducted in a completely differently in this study. In terms of the radicality of the outcomes, challenging views from the field could have raised the ideas in completely new levels. Through successes and failures, an idea can finally lead to new business possibilities. On the other hand, along the way an idea can transform into a completely new one that finally creates new business. The most important aspect of these models is movement and the continuous collection of customer feedback instead of planning matters in isolation. It is difficult to predict reactions something that is completely new (Sandmeier et al., 2004; Sims, 2011; Tuulenmäki, 2012). From this perspective, the access control jewel would be ready for its first, more extensive field test. Time will tell whether this concept will create real business. It may already be

reality when this article is published, as jewels seem to be digitalizing at a fast pace.

The research also brought forth needs for further study – not least due to the fact that this study only dealt with one case. Human-centered systems, such as the studied one, have an enormous number of different variables. It seems important to keep time pressure as a so called standard factor in the studies since, based on the research and despite opposing views, it would appear to be a force that promotes innovation. Also Sherwin (2010) has reached similar conclusions. From stress level point of view, there should be multiple groups working side by side, where the stress level (e.g. required number of new ideas within a given time, etc.) is varied between the groups, applying just the right amount of stress for every group. Especially in group work, it is important to find the most natural way to innovate for everyone. This is influenced by people's habits, ways of working, personalities, and a large number of other human factors.

The research suggests that in the time-pressured FEI the influence of the following factors on the outcome of the FEI process should be studied more:

- A variety of decision-making models and different decision-makers
- Methods that support radical innovation, such as TRIZ
- A heterogeneous and international group
- Only the most committed and motivated persons involved in the innovation team
- A preparatory "test" to select participants for the project
- Working methods that highly encourage people to innovate in the same space and at the same time to achieve genuine collaboration
- Methods that force people to combine their ideas with those of others, e.g. to establish whether this reduces the adverse effects of short cuts people take under time pressure
- An operational model with an even stricter schedule, which would then force innovations

Let us take an example of the last factor. Even a month-long FEI project could entail several forced cycles, i.e. so-called mini sprints. With an agreed specific timetable, each person or team should take turns in adding an agreed number of improvement suggestions to the base idea. Also new ideas created as a by-product of the original idea creation should be recorded, as corresponding cycles could be initiated for them. If the person or team does not respect the agreed schedule, the whole cycle will suffer. Thus, social pressure would guide the actions of people. The cycle would continue until no one has anything to add. It is noteworthy that in this model people could choose whether they want to create ideas alone, in pairs, or in a small team. This allowed everyone to innovate in a way that comes naturally to them. Some feel energized by working alone and some by immediate interaction. On the other hand, even those who work alone receive feedback through the idea cycle.

In addition to the presented 'artificial' forced innovation, people and organizations usually take action after a shock or an exceptionally positive event. For instance, people know very well that they should take care of their health. However, usually they only start to act when faced with a serious illness. Correspondingly, companies start to act only under threat of bankruptcy. Nevertheless, for instance a significant new partner, order, or business opportunity may be surprisingly inspiring. In principle, everyone has

the key to success, but only a few know how to use it in their own organization. Therefore, concrete measures should be sought to motivate busy and stressed modern people and encourage them to act in the best interest of their organization. In innovation, alongside processes and operations models it would then be important to study the human side, which has thus far been neglected in research and especially in practical operations.

8 References

Acur, N., Kandemir, D., de Weerd-Nederhof, P., & Song, M. (2010). Exploring the impact of technological competence development on speed and NPD program performance. *Journal of Product Innovation Management*, *27*, 915-929.

Adams, J.D. (2003, Winter). Successful change: Paying attention to the intangibles. OD Practitioner, 35(4), 22-26.

Apilo, T. & Taskinen, T. (2006). *Innovaatioiden johtaminen*. VTT publications 2330, Otamedia Oy, Espoo.

Apilo, T. (2010). *A model for corporate renewal Requirements for innovation management*. Thesis for the degree of Doctor of Science, VTT publications 750, Edita Prima Oy, Helsinki.

Björk, J. & Magnusson, M. (2009). Where do good innovation ideas come from? Exploring the influence of network connectivity on innovation idea quality. *Journal of Product Innovation Management*, *26*(6), 662-670.

Calantone, R.J., Chan, K., & Cui, A.S. (2006). Decomposing product innovativeness and its effects on new product success. *Journal of Product Innovation Management*, *23*, 408–421.

Carbonell, P. & Rodriguez, A.I. (2006). Designing teams for speedy product development: the moderating effect of technological complexity. *Journal of Business Research*, *59*, 225-232.

Chang, S.-L., Chen, C.-Y. & Wey, S.-C. (2007). Conceptualizing, assessing, and managing front-end fuzziness in innovation/NPD projects. *R&D Management*, *37*(5), 469-478.

Chen, J., Damanpour, F., & Reilly, R. (2010). Understanding antecedents of new product development speed: a meta-analysis. *Journal of Operations Management*, *28*, 17-33

Chiesa,V., Frattini,F. Lucio Lamberti, L. & Noci, G. (2009). Exploring management control in radical innovation projects. *European Journal of Innovation Management*, *12*(4), 416-443.

Cooper, R.G. (2008). Perspective: the stage-gate idea-to-launch process: update, what's new, and Nextgen systems. *Journal of Product Innovation Management*, *25*(3), 213-232.

Crevani, L., Palm, K. & Schilling, A. (2011). Innovation management in service firms: a research agenda. *Service Business*, *5*(2), 177-193.

Defee, C.C & Fugate, B.S. (2010). Changing perspective of capabilities in the dynamic

supply chain era. *International Journal of Logistics Management*, 21(2), 180-206.

Dyer, J., Gregersen, H. & Christensen, C.M. (2011). *The Innovator´s DNA*. Boston Massachusetts: Harward business review press.

Fay, D., Borrill, C., Amir, Z., Haward, R. & West, M.A. (2006). Getting the most out of multidisciplinary teams: a multi-sample study of team innovation in health care. *Journal of Occupational and Organizational Psychology*, *79*, 553-567.

Filippini, R., Salmaso, L., & Tessarolo, P. (2004). Product development time performance: investigating the effect of interactions between drivers. *Journal of Product Innovation Management*, *21*, 199–214.

Goldstein, I. (2013). Scrum Shortcuts without Cutting Corners: Agile Tactics. Tools, & Tips, Addison-Wesley Signature Series.

Gunnar, M. R., & Quevedo, K. (2007). The neurobiology of stress and development. Annual Review of Psychology, 58, 145–173.

Griffith-Hemans, J. & Grover, R. (2006). Setting the stage for creative new products: investigate the idea fruition process. *Journal of the Academy of Marketing Science*, *44*(1), 27-39.

Hyysalo, S. (2006). *Käyttäjätieto ja käyttäjätutkimuksen menetelmät,* Edita.

Kach, A., Azadegan, A. & Dooley, K.J. (2012). Analyzing the successful development of a high-novelty innovation project under a time-pressured schedule. *R&D Management*, *42*(5), 377-400.

Kessler, E.H. & Chakrabarti, A.K. (1999). Speeding up the pace of new product development. *Journal of Product Innovation Management*, *16*, 231-247.

Kessler, E.H. & Bierly, P.E. 2002, Is faster really better? An empirical test of the implications of innovation speed. *IEEE Transactions on Engineering Management*, *49*, 2-12.

Khurana, A. & Rosenthal, S.R. (1998). Towards holistic 'front ends' in new product development. *Journal of Product Innovation Management*, *15* (1), 57-74.

Kim, J. & Wilemon, D. (2002). Focusing the fuzzy front-end in new product development. *R&D Management*, *32*(4), 269-279.

Koen, P., Ajamian, G., Bukart, R., Clamen, A., Davidson, J., D'Amore, R., Elkins, C., Herald, K., Incorvia, M., Johnson, A., Karol, R., Seibert, R., Slavejkov, A. & Wagner, K. (2001). Providing clarity and a common language to the fuzzy front end. *Research Technology Management*, *44*(2), 46-55.

Koen, P.A., G.M. Ajamian, S. Boyce, A. Clamen, E. Fisher, S. Fountoulakis, A. Johnson, P. Puri, & Seibert, R. (2002). Fuzzy Front End: Effective Methods, Tools, and Techniques. In: Belliveau, P. Griffin, A. and Somermeyer, S. (eds.). *The PDMA Toolbook 1 for New Product Development*, (5-35). N.Y.: Wiley.

Kurkkio, M. (2011). Managing the fuzzy front-end: insights from process firms. *European Journal of Innovation Management, 14*(2), 252-269.

Langerak, F. & Hultink, E.J. (2008). The effect of new product development acceleration approaches on development speed: a case study. *Journal of Engineering and Technology Management*, *25*, 157-167.

Langerak, F., Griffin, A., & Hultink, E.J. (2010), Balancing development costs and sales to optimize the development time of product line additions. *Journal of Product Innovation Management*, *27*, 336-348.

Li, H.Y. & Atuahene-Gima, K. (1999). Marketing's influence and new product performance in Chinese firms. *Journal of International Marketing*, Vol. 7, pp. 34-56.

Matthews, K., & Glass, D. (1981). *Type A behavior, stressful life events, and coronary heart disease*. In B. Dohrenwend & B. Dohrenwend (Eds.), Stressful life events and their context. New York.

McDermott, C.M. & O'Connor, G.C. (2002). Managing radical innovation: an overview of emergent strategy issues. *Journal of Product Innovation Management*, *19*, 424-438.

McDermott, C.M. & Handfield, R.H. (2000). Concurrent development and strategic outsourcing: do the rules change in breakthrough innovation? *Journal of High Technology Management Research*, *11*, 35-57.

McEwen, B. S., & Wingfeld, J. C. (2003). The concept of allostasis in biology and biomedicine. Hormones and Behavior, 43, 2–15.

McEwen, B. S., & Stellar, E. (1993). Stress and the individual, mechanisms leading to disease. Archives of Internal Medicine, 153, 2093–2101.

Miles, I. (2000) Service innovation: coming to age in the knowledge-based economy. *International Journal of Innovation Management*, *4*(4), 371-389.

Miller,L., Miller, R. & Dismukes, J. (2006). The Critical Role of Information and Information Technology in Future Accelerated Radical Innovation. *Information Knowledge Systems Management*, *5*(2), 63-99.

Nixon P: Practitioner 1979

Nobelius, D. & Trygg, L. (2002). Stop chasing the front end process – management of the earlyphases in product development projects. *International Journal of Project Management*, *20* (5), 331-340.

Paasi, J., Valkokari, P., Maijala, P., Luoma, T. & Toivonen, S. (2007). Managing uncertainty in the front end of radical innovation development. *Proceeding of 16th International Conference on Management of Technology*. Miami, FL, USA, 13-17 May 2007.

Rehn, a. (2012). Vaaralliset Ideat, Talentum

Sandmeier, P., Jamali, N., Kobe, C., Enkel, E., Gassmann, O. & Meier, M. (2004). Towards a Structured and Integrative Front-End of Product Innovation. *R&D Management Conference (RADMA),* Lisabon, Portugal, 6 July 2004

Selye, H. (1936). *A syndrome produced by diverse nocuous agents*. Nature, 138, 32.

Sherwin, D. (2010). *Creative Workshop: 80 Challenges to Sharpen Your Design Skills*. HOW Books.

Simonton, C., Simonton, S., & Creighton, J. (1978). *Getting well again*. Los Angeles, CA: Tarcher.

Sims, P. (2011). Little Bets: How Breakthrough Ideas Emerge from Small Discoveries.

Free Press

Tache, J., & Selye, H. (1985). *On stress and coping mechanisms*. Issues in Mental Health Nursing, 7, 3–24.

Tuulenmäki, A. (2012). *Lupa toimia eri tavalla.* Talentum.

Vandenbosch, M. & Clift, T. (2002). Dramatically reducing cycle times through flash development. *Long Range Planning*, *35*, 567-589.

Wiseman, L. & McKeown, G. (2010). Bringing out the best in your people. *Harvard Business Review*, May, 117-121.