The Performance Implications of Team Cognitive Styles in the Fuzzy Front End of Radical Innovation Processes

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ABSTRACT

Many prior studies have researched new product development (NPD) team compositions to understand how innovation can be managed effectively. Lately, there has been a growing interest regarding the underlying psychological characteristics of individuals and teams. Certain studies even point out that over longer periods of time cognitive styles will give a better prediction on performance than other factors. This study picks up on this subject and explores the relationship between radical NPD team's cognitive style and how this effects performance, dependent on the phase of the project. Based on survey data from 14 NPD teams stationed in technology-driven manufacturing companies this hypotheses is tested. Results of an independent sample t-test show that there was no significant relationship between the variables in either direction. This paper gives new insights into NPD compositions and warrants future research with stricter data.

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Keywords

New Product Development, Fuzzy Front end, Cognitive Styles, NPD Teams, Analytical Thinking, Intuitive Thinking, Rational Experiential Inventory

5th IBA Bachelor Thesis Conference, July 2nd, 2015, Enschede, The Netherlands.

INTRODUCTION

For companies to keep a competitive edge they need to constantly innovate. Nowadays, organizations will often use new product development (NPD) teams to achieve this goal. However, studies reveal that with failure rates between 30 and 95 percent, there is still a high chance of failure or dropout as innovations progresses through the NPD development stages. Because of these high rates it is not surprising that many studies are centered on finding 'success factors' to increase the chance of developing a successful product.

One of these possible success factors is team composition. Many studies have researched team compositions to understand how innovation can be managed effectively. Attention within the literature has mainly been on functional backgrounds (Lovelace, Shapiro, & Weingart, 2001; Song, Thieme, & Xie, 1998) and demographic characteristics such as education, age and organizational tenure (Hulsheger, Anderson, & Salgado, 2009; Lovelace, Shapiro, & Weingart, 2001).

Beside these surface-level variables there is a growing interest regarding the underlying psychological characteristics of individuals and teams. Leonard & Straus (1997) particularly emphasized that knowledge of cognitive styles are important conditions for managing both performance and potential conflicts within teams. Other studies point out that over longer periods of time cognitive styles will give a better prediction on performance than other factors (Bell, 2007).

A particular study on cognitive styles by De Visser et al. (2014) examined the relationship between the level of teams' cognitive style and performance, depending on the type of innovation (radical or incremental). In this study the expectation was expressed that a positive relationship should exist between performance and an analytical thinking if the innovation was incremental. The reasoning is that incremental innovation, the enhancement of current products, is within logical boundaries. Therefore, it would be more effective to use a team with an analytical mindset. In contrast, the paper also hypothesized that with regard to radical innovation, the creation of a new product, it would be more effective to use intuitive thinkers, because they would need to think outside the box. Although the hypotheses with regard to analytical thinking and incremental innovation was proven, the study also found an unexpected positive effect between analytical thinking and radical innovation.

A possible answer for this inconsistency is the need for different team compositions throughout the NPD process stages. A NPD process exists roughly of 5 stages: (1) Ideation, (2) Investigation, (3) Development, (4) Testing and validation, and (5) Production and market launch (Cooper & Kleinschmidt, 1997). Song et al. (1998) showed that the team composition throughout a NPD process is stage dependent. Thus, for organizations to improve their performance, different team compositions are needed throughout the stages. Although Song et al. (1998) studied the team's functional backgrounds in relation to the stages, this paper will do the same with cognitive styles.

Concerning the need for analytical- and intuitive information processing, a NPD process can be divided into two phases: "the fuzzy front-end" and implementation phase. In this first phase the emphasis will be on creativity (West, 2002), as it requires exploration, out-of-the box thinking, risk taking, a tolerance of mistakes, and openness to the "irrational" (West, 2002; Crawford C. M., Marketing research and the new product failure rate, 1977). These are characteristics that corresponds very well with an intuitive cognitive style. Idea implementation, on the other hand, is a much more formalized and structured process. The teams have to efficiently exploit the information gathered in the first phase and spend their time mainly on technical tasks. Therefore, creativity is much less utilized in the second phase and tasks should be performed based on efficiency. Because the tasks in the second phase are more mechanistic and based on formalities and routines, an analyst should function better. They are characterized as individuals who pay attention to detail and work in a step-by-step manner (Armstrong, Cools, & Sadler-Smith, 2012, p. 252).

This study will explore if this actually is the case, and will test the effects of cognitive style of NPD teams on performance, dependent on the phase of the project. Data was used from prior research which had to be altered to fit the current study. After the removal of redundant data a total of 14 applicable groups were found, with 3 groups matching an intuitive dominant style in the fuzzy front end and a dominant analytical style in the latter phase. A independent sample t-test was performed to test the hypotheses. However no significant relationship was found.

THEORETICAL BACKGROUND

After losing appeal in the late 1970s among psychologists, cognitive style has found a re-emergence of interest in the applied fields such as education, medicine and business & management (Armstrong, Cools, & Sadler-Smith, 2012). Researchers see cognitive styles as a potential variable for comprehending and predicting behavioral differences in organizations at both the individual level and the group level (De Visser, Faems, Visscher, & De Weerd-Nederhof, 2014; Hodgkinson & Sadler-Smith, 2003; Armstrong & Priola, 2001). The cognitive style of a person determines the way he or she "perceives, thinks, solves problems, learns, and relates to others". It influences how a person finds information in the environments, how they organize and interpret it, and how they integrate their interpretations into mental models and subjective theories that guide their behavior (Allinson & Hayes, 1996; Witkin, 1973). Based on the cognitive style of a person, certain job types are likely to fit particular styles better (Armstrong, Cools, & Sadler-Smith, 2012). A study by Chan (1996) predicted that under the condition of a mismatch between the cognitive style, and the demands and tasks a lower performance can be expected.

Cognitive styles can be broken down in many different ways. This study will focus on the distinction between analytical- and intuitive cognitive thinking. An analyst can be described as someone who pays attention to detail, focuses on 'hard data' and adopts a sequential, step-by-step approach to processing information (Armstrong, Cools, & Sadler-Smith, 2012, p. 252). Intuitives, on the other hand, are less concerned with detail, more receptive to 'soft' data, and emphasize synthesis and simultaneous integration of many inputs at the same time (Armstrong, Cools, & Sadler-Smith, 2012, p. 252). Multiple studies (Armstrong & Priola, 2001; Priola, Smith, & Armstrong, 2004) show that individuals with either an analytical- or intuitive cognitive style

function better in certain job environments. Intuitive workers outperformed analysts under the condition that the job was described as unstructured and organic. Analytical people, on the other hand, were better suited in environments that are structured and mechanistic.

This study follows Epstein et al. (1996) on their construct of the cognitive thinking style of NPD team members. Based on NPD literature different phases within a NPD project may very well effect the relationship between team cognitive styles and project performance. Below, hypotheses are shown regarding the effect of team cognitive style on overall NPD project performance in different NPD project phases.

HYPOTHESES

To create a radical new product the NPD-team will need to go through different stages of the NPD process. These stages are comprised of routines. An 'organizational routine' can be described as a sequence of actions that has been 'learnt' through experience. These experiences are stored through formal structures, procedures, and processes. Because the routines are imbedded they can exist independently and used on different cases (Conway & Steward, Managing and Shaping innovation, 2009). Past studies (Cooper, Robert, Kleinschmidt, & Elko, 1988; West, 2002) show a big difference between the first and latter stages in terms of activities and possibilities to imbed these stages in routines.

The first stages of the process can be described as 'the fuzzy front-end'. This phase encompasses everything leading up to the implementation of the generated idea (Verworn, Herstatt, & Nagahira, 2008; Cooper, Robert, Kleinschmidt, & Elko, 1988) and is often associated with out-of-the-box thinking, exploration, risk taking, and tolerance of mistakes (West, 2002; Crawford C. M., Marketing research and the new product failure rate, 1977). The second phase, the implementation phase, often happens in organizational constraints (West, 2002) and tends to be a more formalized process. A study by Song et al. (1998) on NPD team's composition regarding functional backgrounds showed that the actual team composition is stage dependent. The paring of employees from the marketing, R&D and manufacturing department were dependent on the stage of the NPD project.

This insight shows that the team composition regarding functional backgrounds will need to be different throughout the stages to perform effectively. This study uses these insights and applies it to cognitive styles to determine whether there is a relationship between cognitive styles and performance, dependent on the NPD process phase.

THE 'FUZY FRONT END' AND COGNITIVE THINKING

The first stages of a NPD project are described as the 'fuzzy front-end'. A term first made well known by Smith and Reinertsen (1991). This stage roughly includes the period from idea generation to the 'go/no-go' decision for development (Verworn, Herstatt, & Nagahira, 2008; Cooper, Robert, Kleinschmidt, & Elko, 1988). It marks the beginning of every NPD project and will decide the path the new product will take. In many cases it is the root of success for firms involved with radical new product development (Reid & De Brentani, 2004). Examples of activities performed in the fuzzy front-end are the structuring of the problem or opportunity (Leifer, O'Connor, Colarelli O'Connor, Peters, Rice, & Veryzer, 2000), collecting and analyzing information (March, 1991), doing "up-front homework" (Cooper R. G., 1996), idea generation and concept development (Crawford & Di Benedetto, 2003). Studies have used numerous models to describe the different stages of a NPD project. This study uses the 5 stage model of Cooper & Kleinschmidt (1997) to illustrate the different stages present in a NPD process. Herein the "fuzzy front-end" will consist of the ideation- and investigation stage.

The execution of the fuzzy front-end depends greatly on the type of innovation (i.e. incremental or radical innovation). Reid & De Brentani (2004) suggested that one of the differences is the structuring of problems and the information searching. For incremental new products the fuzzy front-end is a much more structured process. Generally, problems and opportunities are formulated at the organizational level, and from there on are redirected to individuals for information gathering. These methods of data collection will often be based around already existing compiling techniques in the organization (Clark & Weelwright, 1993). Within an incremental NPD process, the organization will be participating from the very start. Therefore the fuzzy front-end will be a much more formalized process. Radical NPD processes, on the other hand, are fueled by individuals also described as champions (Burgelman & Sayles, 1986). These individuals will bring unstructured information without an incentive from leading figures of the organization. These individuals make a large contribution at the start of the process and also actively promote the progress. In this situation the incentive is given to the individuals and through them the information is brought upstream. Therefore, within a radical innovation process individuals have a high importance and room for creativity, freedom and making individual choices is much greater than within an incremental NPD process.

At the fuzzy front-end the emphasis is on exploration, out-of-the box thinking, risk taking, a tolerance of mistakes, creativity and openness to the "irrational" (West, 2002; Crawford C. M., Marketing research and the new product failure rate, 1977). These are all characteristics that coincide with intuitive cognitive thinking.

THE IMPLEMENTATION PHASE AND COGNITIVE THINKING

The latter stages of the project can be described as the idea implementation phase. In this phase the emphasis is on the execution of the initial idea produced through idea generation. Within the model of Cooper (1996) the implementation phase consists of development stage, testing and validation stage, and the production and market launch stage.

When the NPD process proceeds to the implementation phase the process will be adapted to organizational circumstances and will be stabilized (West, 2002). Stabilization is reached through the involvement of many more people. These people are often formed in several formal multifunctional teams, which will lead to a more structured way of working and less need for creativity (Stevens, Burley, & Divine, 1999). Plans and concepts have to be translated into

reality and therefore actual task work needs to be done (Hoegl, Weinkauf, & Gemuenden, 2004). The teams in the second phase will have to efficiently use the collected data and will be mainly occupied with technicalities (Tushman, 1977; Pinto & Prescott, 1988). Therefore, within this phase of the project the room for creativity, freedom and individualistic choice is vastly restricted.

De Visser et al. (2014) did a study centered on the hypotheses that analytical processing will have a negative effect on project performance in a radical NPD process. However, in contrast to the hypothesis, a positive relationship between team analytical processing and performance was found. The process of formalization throughout the stages can be a possible explanation. Within this reasoning intuitive thinking will only be beneficial in the first phase, while analytical thinking is required in the other stages of the NPD process.

Hypotheses: Teams in radical NPD projects with a dominant intuitive cognitive style in the fuzzy front end, and a dominant analytical cognitive style in the latter phase perform better than teams with other compositions.

METHODOLOGY

Sample

To execute the test, data is needed concerning the following attributes: the cognitive styles of the project team members and the performance assessed by the team members to the project. Unfortunately, this kind of data is not publicly available. Therefore, data was used that was collected in a previous study by De Visser et all (2014).

The data consists of a selection of companies who (1) have a broad portfolio of NPD projects in their research and development (R&D) department, (2) were willing to provide access to their project documentation system, and (3) were situated in technology-intensive manufacturing industries. Data collection was originally done through personal networking. In total four companies participated in the study from different industries such as rubber tires, sensors and controls, membrane technologies and plastic pipes. A number of NPD projects over the past 5 years were identified through the use of the project documentation systems of the companies. Also, individual members of the projects were identified on the basis of working hours on a particular project. When a team member had more than 100 working hours on the project he was selected. A further check was done through the project manager, who had to verify that the team member was part of the team. Therefore, the group was defined as 'the group of organizational members that was responsible for developing the product or product component in a particular project (De Visser, Faems, Visscher, & De Weerd-Nederhof, 2014).

Unfortunately, this data still consisted of information of both team members of incremental- and radical innovation projects. This study focuses exclusively on team members working on radical innovation projects and therefore the writer had to remove redundant data to make it applicable for this study. To determine the segregation between incremental and radical innovation projects the matrix of Roussel was used. This matrix consist of two determinants: (a) core target market of the project, and (b) core technology of the project. The respondents had to choose between three options to determine the position of their own project within the matrix. The respondents had to choose between (1) known to a/b, (2) new to a/b, and (3) new to the world (See appendix A). This will result in a certain score. If this score was 5 or higher, the writer segregated the project as radical and the data was kept, otherwise it was removed from the dataset.

After the data removal a final sample of 14 project teams remained. The average team size of the dataset totaled at 3.6 individuals. The minimum team size contributed to two individuals and a maximum was found at eight individuals. There was a clear cut between teams consisting of two organizational members and team with more than two organizational members, scoring both 50 percent. The average age of the individuals was 39 years and 92% were male. Within these 14 teams, four matched the composition of a dominant intuitive cognitive style in first phase and an analytical cognitive style in the second phase.

Due to the assurance that the companies would remain anonymous, no further specifics will be given in this paper.

Measures

Dependent variable: project performance. This study will define project performance as the extent to which a team is able to meet established project objectives. The scale of Hoegl et al. (2004) is used to measure project performance. This scale is based on five parts consisting of (1) project success, (2) achievement of project goals, (3) output quality, (4) team satisfaction about project performance, and (5) top management satisfaction about project progress. Team members were asked to base their performance on this scale (Cronbach's alpha = 0.73).The team members needed to select a number ranging from one to five determining the project performance within that part. Every question contributes for 20 percent of the total score. The individual scores will be added and averaged out to get the individual overall project performance scores. Hereafter, the average score of every team is calculated to acquire the variable "Performance". The mean individual overall project performance score lies at 3,40, with a standard deviation of 0,61, a minimum of 2,00 and a maximum of 4,80. The mean team overall project performance lies at 3,43, with a standard deviation of 0,43, a minimum 2,70 and a maximum of 4,20.

Independent variable: team intuitive- and analytical processing. To construct this variable, this paper had to determine two facts: (1) the individual cognitive style of the team members, and (2) the dominant team cognitive style dependent on the stage. To determine the NPD team members cognitive style this paper uses the rational experiential inventory (REI) scale created by Epstein et al. (1996). This is a self-report questionnaire and has two unipolar scales (e.g. "I can be an analytical person" and "I can be an intuitive person). This in contrast to other measurement methods like the cognitive style index (CSI) from Allison & Hayes (1996) which uses an bipolar scale that suggests that a person can either process information analytically or intuitively. However, the REI will be used in the same way as the CSI, as in it will determine a person job fit (Allinson & Hayes, 1996).

For this paper the 31-items of the REI were brought back to 10 items, based on the highest factor loadings reported by Epstein et al. (1996). The 10 items are evenly divided for intuitive- and analytical processing. The respondents could state their opinion on the items by selecting a number in a 7 point scale. With 1 being "strongly disagree" and 7 being "strongly agree". A higher score means the respondent would be more analytical or intuitive. For each respondent two scores were calculated by multiplying the points of the 5 intuitive- and 5 analytical items. To determine whether the respondents where analytical and/or intuitive the mean scores of all the respondents were calculated. If the respondent had a higher score than the mean he was selected as having that certain cognitive style.

To determine the dominant team cognitive style for both the "fuzzy front end" phase and the implementation phase, respondents were asked to allocate a total of 100 percentage points of their individual project time to the five project phases described by Cooper & Kleinschmidt (1997). It has to be stressed that prior research could not be found regarding the allocation of the "fuzzy front-end" en the implementation phase, therefore this paper determined that an individual is dominant in the first phase when he or she had 50 or more percentage points of their individual project time allocated to the first two stages. Otherwise the individual was dominant in the second phase.

To determine the group's dominant cognitive style in a certain phase, the paper categorized it, in line with prior research (De Visser, Faems, Visscher, & De Weerd-Nederhof, 2014; Erez & Naveh, 2011), by the amount of people with the same cognitive style. For example, if three group members were dominant in the first phase and two would have an analytical cognitive style, the dominant style would be regarded as analytical. In case both cognitive styles were evenly represented it would be labeled as "?". If the intuitive cognitive style was dominant in the fuzzy front stage and the analytical cognitive style was dominant in the latter stages, the NPD team would be classified in the "intuitive-analytical" group, otherwise the team would automatically be categorized in the "other" group.

Moderate variable. Project phase. This paper hypothesizes that the project phase moderates the relationship between project performance and team intuitive- and analytical processing. The individual project time table created by Cooper & Kleinschmidt (1997) will be used to identify the different stages. The first two stages: (1) ideation, (2) investigation, will be pooled together forming the "fuzzy front" stage. The last three stages will be referred to as the "implementation phase" and will consist of (1) development, (2) testing and validation, and (3) production and market launch.

Statistical Tests

Independent samples t-test: This study wants to establish if there is a real difference in performance between NPD groups with a dominant intuitive cognitive style in the first phase and a dominant analytical style in the second phase, compared to other group compositions. In this study the mean performance of both groups will be compared. Due to the fact that two groups are compared and both groups are independent of each other, according to statistical literature, an independent samples t-test is an appropriate choice, relative to a paired samples t-test and a one sample t-test (De Veaux, Vellemean, & Bock, 2011).

RESULTS

Boxplots, Independent Samples t-test

As prescribed by De Veaux et al. (2011) this paper will start with a boxplot to compare both groups before conducting an independent samples t-test. Also a chart with regard to the mean group performance and a table representing the means of both groups were added to further illustrate the performance differences. The "intuitive-analytical" group (n=3) has a mean performance of 3,58 with a standard deviation of 0,57. In comparison, the "other" group (n=11) has a mean performance of 3,38 with a standard deviation of 0,41.

In line with the expectations, the "intuitive-analytical" group has a higher average performance compared to the "other" group. The boxplot for the "other" data identifies two possible outliers. However, with only 14 measurements, the outlier nomination rule is not very reliable (De Veaux, Vellemean, & Bock, 2011). Therefore, this paper will leave the values in the data.

An independent samples t-test can examine whether there is an statistically significant difference in performance between groups with an intuitive-analytical composition in comparison with other team compositions. Firstly this paper will check the assumptions and conditions.

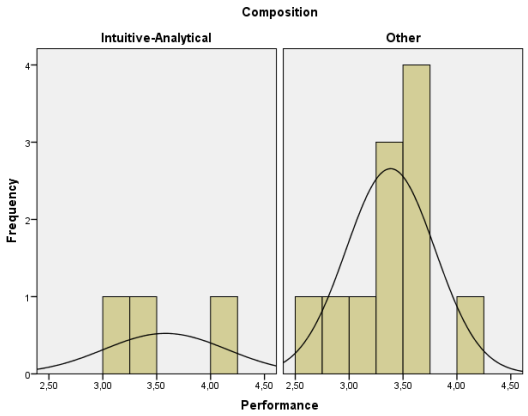


Figure 1: histogram of the performance assessment of the intuitive/analytical group (left), and "other" group (right)

Independence assumption: The performance assessed by one group should be independent of the assessment of another group.

Randomization condition: Because external data was used, it is hard to determine to what extent the groups were randomly selected.

Independent groups assumption: The groups are derived from four different companies, which are active in different industries. Therefore, it can be assumed that the NPD groups do not affect each other intensively. However, team members can be present in more than one group. This is the case in 5 samples, although it only occurred in the "other" group. Therefore, this paper

assumes the two groups that are compared should be independent.

Nearly normal condition: Looking at figure 1 it looks like both groups have a nearly normal distribution. However, when sample sizes are small (n < 15) this condition must be met with extra care (De Veaux, Vellemean, & Bock, 2011). Therefore this paper will utilize a Shapiro-Wilk normality test to conclude if the "other" group's performance assessment is normally distributed.

Looking at the output data found in Appendix B, a value of p = 0,668 is found for the "intuitive-analytical" group, and a p = 695 for the "other" group. With α = 0,05 it is clear that the distribution is normal in both cases. Therefore, the nearly normal condition is met.

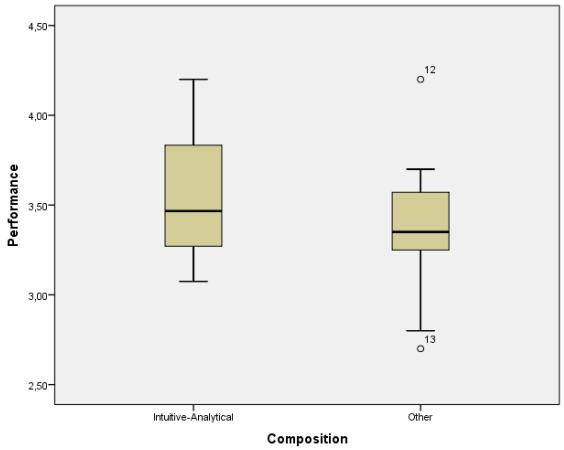


figure 2: Performance assessment of intuitive/analytical group (left) and "other" group (right)

An independent-samples t-test was conducted to compare the performance between "intuitive-analytical" groups and groups with other compositions. There was not a significant difference in the scores for "intuitive-analytical" (M=3,58, SD=0,57) and "other" (M=3,38, SD=0,41) groups; t(12)=0,68, p=0,509. These results suggest that a group composition with a dominant intuitive cognitive style in the fuzzy front end, and a dominant analytical cognitive style in the latter phase don't effect the performance for a radical NPD project in either direction.

DISCUSSION

Team cognitive style, NPD-stages and Performance

This study identifies the contribution of NPD groups' cognitive style in association with the "fuzzy front-end" and the implementation phase. How the "fuzzy front-end" is executed depends on whether an innovation is either incremental or radical. Incremental innovation is urged at the organizational level and will often be based around existing methods, and thus is a more formalized process. In contrast, the incentive for radical innovation is given through individuals, and through them information is brought up-stream. In this situation there is a lack of formalization and routines at the start of the process. Therefore, at the "fuzzy front-end" in a radical NPD process the emphasis is on being creative and taking risks (West, 2002; Crawford C. M., Marketing research and the new product failure rate, 1977).

Team members with an analytical cognitive style should generally match better with formalized work as they are characterized with paying attention to detail, focusing on 'hard data' and adopting a sequential, step-by-step approach to process information (Armstrong, Cools, & Sadler-Smith, 2012, p. 252). Intuitives, on the other hand, are characterized with less concern for detail, more receptive to 'soft' data and the integration of many inputs at the same time (Armstrong, Cools, & Sadler-Smith, 2012, p. 252).

This paper therefore expected that a NPD team composition with a dominant intuitive cognitive style in the "fuzzy front end" phase and a dominant analytical cognitive style in the implementation phase would perform better than other NPD team compositions. This was tested through an independent sample t-test. However, in contrast to this papers expectation no significant relationship was found between team cognitive style dependent on the NPD stage and performance.

A possible explanation for this finding is the importance of a third cognitive style: 'conformists'. As stated above, in contrast to incremental innovation, radical innovation is urged through individuals. This often will be an individual with an intuitive cognitive style as they are more creative. Creative members are focused on generating ideas and revealing new problems and solutions (Tagger, 2001). However, they also deviate from group norms leading to enhanced task conflict (Erez & Naveh, 2011). Conformists can erase these conflicts and help get the original ideas of the champion through the NPD process. Conformity is the tendency of the individual to solve problems within given constraints (Kirton & Holland, 1976; Miron, Erez, & Naveh, 2004). Conformists are the glue in the team. They help preserve group norms and structures, and because of their group dependence help keep the group in harmony (Kirton & Holland, 1976). A study by Erez et al. (2011) found that adding conformists to a NPD project dominated by intuitive team members has a positive effect on team radical innovation. This contribution even went beyond that of the intuitive members, thus stating the importance of this type of team member. In this study cognitive style was divided between analytical and/or intuitive team members. A conformist would section itself in the analytical group as a conformist is not creative. Therefore, this paper points out the need for further research with the inclusion of the conformist cognitive style.

Limitations and Future Research

One of the main constraints of this research was the limited sample size. Data was used from prior research and was altered to suit the research question. For the alteration of the data a number of concessions had to be made to increase the sampling size and also make the data applicable for testing.

In the first place concessions had to be made for the categorization of radical innovation. This paper selected a project as radical if the score was 5 or higher (Appendix

A). However, a score of 5 means that for both market as technology, the innovation wouldn't have to be new to the world. If a stricter number was chosen a large portion of the sampling size would have been removed. For future research it is suggested to use a stricter method for defining a radical project.

Second, most of the respondents participated in the latter phase of the NPD project. A percentage had to be given for the contribution that was made in every stage. In most cases a larger percentage was given to the latter stages, therefore categorizing the members in the latter phase. In this dataset not many participants were active in the fuzzy front end. It also has to be stated that in many cases when a respondent was dominant in the fuzzy front end, the respondent would have selected their contribution at 50 percent. For future research a larger sample of team members in the fuzzy front end is advised, who are also more dominant in this phase.

Third, the team sizes ranged from 2 to 8 team members. With 50 percent being two members. This probably relates to the sampling method. Only team members were selected with a minimal number of 100 working hours. Therefore, a large portion was excluded from the research. These members all have a certain cognitive style that will impact the group process. By narrowing down the parameters of exclusion of team members a better estimate of a dominant cognitive style can be given, or likewise data can be collected from larger NPD groups, keeping the parameters in check.

Fourth, data collection was done through questionnaires. This yields a couple of limitations. In the first place, the collection method provides subjective measures. For instance performance and CSI are based on the group's own perception. In total four different companies were used for data collection. Between these four companies criteria for performance can differ, as well as between groups and individuals. Also, the Hawthorne-effect could be present. Subjects know they are being examined. This can influence their assessment as they could purposely overestimate their own performance. Including more objective measures can help future research.

What also must be expressed is the background of the studied companies. All are situated in technology-driven manufacturing companies. It is therefore expected that for the most part problems will be solved regarding technology and mathematics, which normally require analytical processing (Denes-Raj & Epstein, 1994). The importance of an analytical cognitive style within NPD team composition may be less relevant in other sectors. For further research it is advised that companies within other sectors are included.

CONCLUSION

This paper tried to find a significant relationship between radical NPD team's cognitive styles and performance, dependent on the phase of NPD project. Unfortunately, no relationship was found between the variables. Also a number of recommendations were made. I hope that this study will help aid future research with regard to the composition of NPD project team and that this will give new insights on this topic.

REFERENCES

Allinson, C., & Hayes, J. (1996). The Cognitive Style Index. *Journal o*, pp. 119-135.

Armstrong, S. J., & Priola, V. (2001). individual differences in cognitive style and their effects on task and social orientations of self-managed work teams. *Small Group Research*, 283-312.

Armstrong, S. J., Cools, E., & Sadler-Smith, E. (2012). Role of Cognitive Styles in Business and Management: Reviewing 40 Years of Research. *International Journal of Management Reviews*, 238-262.

Bell, S. T. (2007). Deep-level composition variables and predictiors of team performance a meta-analysis. *Journal of Applied Psychology*, 595-615.

Burgelman, R. A., & Sayles, L. R. (1986). *Inside Corporate Innovation.* New York: Macmillian.

Chan, D. (1996). Cognitive misfit of problem-solving style at work: a facet of person-organisation fit. *Organisational Behavior and Human Decision Processes*, 194-207.

Clark, K. B., & Weelwright, S. C. (1993). *Managing New Product and Process Development.* New York: The Free Press.

Conway, S., & Steward, F. (2006). *Managing and shaping innovation.* New York: Oxford University Press.

Conway, S., & Steward, F. (2009). *Managing and Shaping innovation.* New York: Oxford University Press inc. .

Cooper, R. G. (1996). Overhauling the New Product Process. *Industrial Marketing Management 25*, 465-482.

Cooper, Robert, G., Kleinschmidt, & Elko, J. (1988). Predevelopment activities determine new product. pp. 237–247.

Crawford, C. M. (1977, April). Marketing research and the new product failure rate. pp. 51-61.

Crawford, C. M. (1977, April). Marketing research and the new product failure rate. *Journal of Marketing*, 51-61.

Crawford, C. M. (1987). *New Products Management.* Homewood: IL: Irwin Publisher.

Crawford, C. M., & Di Benedetto, A. (2003). *New Products management 7th edition.* New York: McGraw-Hill/Irwin.

De Veaux, R. D., Vellemean, P. F., & Bock, D. E. (2011). *Stats: Data and Models.* Pearson Education.

De Visser, M., Faems, D., Visscher, K., & De Weerd-Nederhof, P. (2014). The Impact of Team Cognitive Styles on Performance of Radical and Incremental NPD projects. *Journal of Product Innovation Management*, 1167-1180.

Denes-Raj, V., & Epstein, S. (1994). Conflict between intuitive and rational processing: When people behave against their better judgement. *Journal of Personaliity and Social Psychology*, 819-29.

Erez, M., & Naveh, E. (2011). The Effect of Coformist and Attentive-To-Detail Members on Team Innovation: Reconciling the Innovation Paradox. *Academy of Management Journal*, 740-760.

Ettlie, J. E., Bridges, W. P., & O'Keefe, R. D. (1984). Organization Strategy and Structural Differences for Radical Versus Incremental Innovation. *Management Science*, 682 - 695.

Hodgkinson, G. P., & Sadler-Smith, E. (2003). Complex or Unitary? A critique and empirical re-assessment of the allinson-Hayes Cognitive Style Index.

Journal of Occupational and Organizaional Psychology, 243-268.

Hoegl, M., Weinkauf, K., & Gemuenden, H. G. (2004, January). Interteam Coordination, Project Commitment, and Teamwork in Multiteam R&D Projects: A Longitudinal Study. *Organization Science*, pp. 38-55.

Hulsheger, U. R., Anderson, N., & Salgado, J. F. (2009). Team-level predictors of innovation at work: A comprehensive meta-analysis spanning three decades of research. *Journal of Applied Psychology*, 1128-1145.

Kirton, M. J., & Holland, W. E. (1976). Adaptors and innovators: A description and a measure. *Journal of Applied Psychology*, 622-629.

Leifer, R., O'Connor, C., Colarelli O'Connor, G., Peters, L. S., Rice, M., & Veryzer, R. W. (2000). *Radical Innovation: How Mature Companies Can Outsmart Upstarts.* Boston: MA: Harvard Business School Press.

Lovelace, K., Shapiro, D. L., & Weingart, L. R. (2001). Maximizing crossfunctional new products teams' innovativeness and constraints adherence: A conflict communications perspective. *Academy of Management Journal 44*, 779-93.

March, J. G. (1991). Exploration and Exploitation in Organizational Learning. *Organizational Science 2*, 71-87.

Miron, E., Erez, M., & Naveh, E. (2004). Do personal characteristics and cultural values that promote innovation, quality, and efficiency compete or complement each other? . *Journal of Organizational Behavior*, 175-199.

Moenaert, R. K., De Meyer, A., Souder, W. E., & Deschoolmeester, D. (1995). R&D/marketing communication during the fuzzy front-end. *Engineering management 42*, 243-258.

Pinto, J. K., & Prescott, J. E. (1988). Variations in Critical Success Factors Over the Stages in the Project Life Cycle. *Journal of Management*, 5-18.

Priola, V., Smith, J. L., & Armstrong, S. J. (2004). Group work and cognitive style: a discursive investigation. *Small Group Research*, 565-695.

Reid, S. E., & De Brentani, U. (2004). The Fuzzy Front End of New Product Development for Discontinuous Innovations: A Theoretical Model. *Journal of Product Innovation Management 21*, 170-184.

Smith, P. G., & Reinertsen, D. G. (1991). *Developing Products in Half the Time.* New York: Van Nostrand Reinhold.

Song, M. X., Thieme, J. R., & Xie, J. (1998). The impact of cross-functional joint involvement across product development stages: an exploratory study. *Journal of product innovation management*, 289-303.

Stevens, G., Burley, J., & Divine, R. (1999). Creativity + Business Discipline = Higher Profits Faster from.

Tagger, S. (2001). Group composition, creative synergy and group performance. *Journal of Creative Behavior*, 261-284.

Taylor, A., & Greve, H. R. (2006). Superman or the fantastic four? Knowledge combination and experience in innovation teams. *Academy of Management Journal*, 723-740.

Tidd, J., & Bessant, J. (2009). *Managing Innovation: Integrating Technological, Market and Organizational Change 4th edition.* Chichester: John Wiley & Sons Ltd.

Tushman, M. L. (1977, December). Special Boundary Roles in the Innovation Process. *Administrative Science Quarterly*, pp. 587-605.

Verworn, B., Herstatt, C., & Nagahira, A. (2008, January 19). The fuzzy front end of Japanese new product development projects: impact on success and differences between incremental and radical projects. *R&D Management*, pp. 1-19.

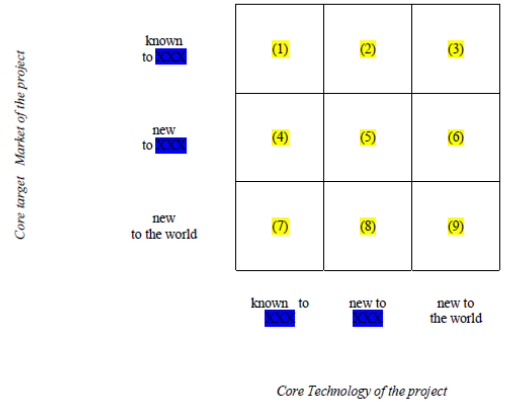
West, M. A. (2002). Sparkling fountains or stagnant ponds: An integrative model of creativity and innovation implementation in work groups. *Applied Psychology: An Internation Review 51*, pp. 355-386.

Witkin, H. A. (1973, June). The Role of Cognitive Style in Academic Performance and in Teacher-Student Relations. *ETS Research Report Series*, pp. 1-58.

APPENDIX A

Project typification (Roussel)

PTYPE Please put a mark in the table on the right;
Where would you position this particular project in the matrix?



APPENDIX B

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Composition	Statistic	df	Sig.	Statistic	df	Sig.
Performance	Intuitive-Analytical	,246	3	.	,970	3	,668
	Other	,146	11	,200*	,954	11	,695