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PERCEIVED EFFECTIVENESS OF CREATIVE NEW PRODUCT DEVELOPMENT IN VIRTUAL TEAMS

Abstract. *Virtual teams are arising as a new trend in New Product Development (NPD). They are perceived to be highly creative in reaching suitable new product solutions, as they are not limited by local resources, organizational boundaries and climate. In this paper we study how students involved in NPD in virtual environments perceive their creative effort and final NPD result – development of a functioning prototype. We approach and study the presented issue on a 2011 generation of Engineering and Design students involved in a design course entitled European Global Product Realization. This project has been developed by 5 European Universities to enable students to gain practical experience in virtual product development. The results show that the students do not perceive working in virtual environments as relevant for creativity. On the other hand, however, working in virtual teams induces effectiveness of creative new product development, directly, as well as indirectly through the structure of the design process. Similarly, the students also perceive creativity to have a positive effect on the design process, as well as on the final NPD result. The results only partially support the notion that virtual teams are highly creative in NDP.*

Keywords: *perceived NPD (new product development) effectiveness, creativity, virtual teams, EGPR*

Introduction

New product development (NPD) is considered to be a vital component of a firm (Badrinarayanan and Arnett, 2008), because if it is effective, it can mean a great competitive advantage and consequently represents the key to

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firms' survival and growth. Contemporary organizations, faced with global competition and external environmental turbulence, require highly creative NPD teams to survive. Often it is very difficult to provide the necessary abilities for a new market or a product from inside the firm on time. To achieve creativity in such environments the firms therefore need to search outside the firm and use external resources of recruitment in order to achieve effective NPD. They engage and cooperate with other functions and institutions beyond the boundaries of the organization, industry and even state. This trend, combined with geographic dispersion, technology development and increased growth of teamwork in organizations resulted in formations of virtual teams of people who work interdependently across space, time and organizational boundaries on solving NPD problems (Nemiro, 2002; Gaudes et al., 2007; Verburg and Bosch-Sijtsema, 2007). Such teams are presumed to be more creative, because they are not bound by the local resources, organizational boundaries and climate. They are increasingly becoming crucial components of a firm's overall marketing strategy (Sarin and McDermott, 2003).

With the development of such teams the question of their effectiveness and creativity in NPD is therefore raised. There has been extensive research done on different performance and attitude variables associated with the work and effectiveness of face-to-face teams in comparison with the virtual teams (i.e. Warketin et al., 1997; Staples and Webster, 2007). Several studies also considered the role of creativity in (traditional) NPD teams (Amabile, 1997; McAdam and McClelland, 2002; Im and Workman Jr., 2004; Martins and Terblanche, 2003), since it is considered to be one of the key factors influencing NPD effectiveness. Although authors (Amabile, 1997; McAdam and McClelland, 2002; Im and Workman Jr., 2004; Martins and Terblanche, 2003) found creativity to be a preliminary condition for innovation, literature on creativity within virtual NPD teams and its effect on the final NPD result is rare. There are only a few studies from real business environments on this topic (i.e. Nemiro, 2002; Leenders et al., 2003). We aimed to fill this gap by conducting an explorative study (for details see Fain and Kline, 2010), where we tested one of the rare models for the study of creativity in virtual teams (Nemiro, 2002; Nemiro, 2004). The results of the study were, however, controversial. This paper aims at re-testing the studied data on a new sample.

Similarly as in the first attempt, we approach and study the presented question on an example of a design course entitled European Global Product Realization (EGPR) that applied a practical, global, multicultural, multinational and multidisciplinary (multi-x) design environment in order to enable students to gain practical experience in virtual product design.

The choice to study a virtual NPD team in an educational environment came from several influencing factors. First of all, the rapid developments

in business and NPD practice mentioned earlier, call for ongoing educational responses. Educational institutions need to be proactive in meeting the emerging needs of NPD. Design education should enable students to get the necessary competences that allow them, when they become professional designers, to face the challenges yielded by the new trends in current real-world NPD problems (Horvath et al 2004). Design students should be prepared to follow the emerging trend in industry that consists of forming multi-x teams that work in a virtual environment where the boundaries of institutions participating in creative development processes are vague. They can achieve this only if such practice is already implemented in their design education program. Second, several universities have already reacted to the trend of institutional cooperation beyond the boundaries of single organizations, as cooperation with industry in real and virtual NPD projects is increasingly becoming a part of design education (Žavbi and Tavčar, 2005), meaning that such universities are also a part of the emerging virtual relations in (real) business practice. Finally, there has been little research done on how to implement and establish creativity of virtual teams within design education to develop the competences of students so that they can smoothly transfer from the university to their jobs after graduation. We argue that EGPR is an example of good business and educational practice in an emerging NPD environment.

To provide the case for the (re)structuring of the proposed model, we repeated a sample survey among the student teams participating in EGPR in 2011. It has been constructed according to Nemiros' (2004) guidelines and modified according to the findings of the pilot study (for details see Fain et al., 2008). The study should provide further insight into the perception of creativity and NPD effectiveness in virtual teams.

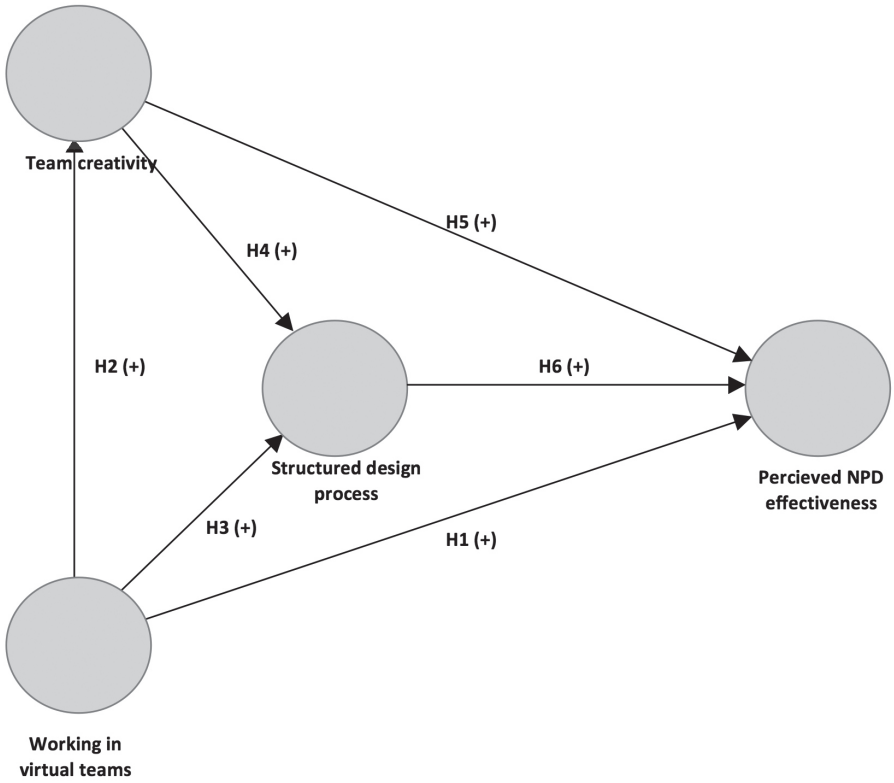
The rest of the paper is structured into four sections. First, we give an outline of the conceptual framework of creative NPD within virtual teams and we postulate the hypotheses. We give detailed descriptions on how and why virtual teams are presumed to foster NPD effectiveness and what the roles of creativity and the structured design process in achieving the desired effectiveness level of NPD are. In the next section, the research method is presented along with an outline of the EGPR course. Results follow in section 4. Discussion and conclusions are outlined in the last two sections.

Conceptual framework and hypotheses

Figure 1 presents our theoretical model. Following the literature review, the model hypothesises that the perceived effectiveness of the NPD process depends on the structured design process, creative effort and the virtual characteristics of the design environment. This model is deeply influenced by

Nemiro's (2004) work, which is to our knowledge the only empirical study that deals with creativity in virtual teams in a systematic way. Nemiro's (2002; 2004) work and consequently the proposed conceptual framework are based on the presumption that virtual teams allow companies to tap into the best talent to create the highest quality and fastest response to customer needs. They can leverage their expertise by putting people together without relocating them. Such structures are presumed to influence the levels of NPD effectiveness and team creativity as they offer openness, flexibility and diversity.

Figure 1: A CONCEPTUAL FRAMEWORK FOR THE STUDY OF EFFECTS OF VIRTUAL TEAMS ON CREATIVITY IN NPD



The advantages of forming virtual teams include independence from time and space constraints, reduced opportunity costs, greater flexibility in meeting market demands, and better integration of knowledge from members in remote locations (Badrinarayanan and Arnett, 2008). Such teams are consequently presumed to be more creative, because they are not bound by the local resources, organizational boundaries and climate. They are

becoming crucial components of a firm's overall marketing strategy (Sarin and McDermott, 2003). As such, they are also presumed to influence the design process within NPD, all for the purpose of raising NPD effectiveness. With this notion in mind, we put forward our hypotheses. The hypotheses, derived from the proposed framework are the result of an in-depth literature review within the fields of NPD in virtual environments (H1, H2 and H3), team creativity (H4, H5) and design processes (H6).

Virtual teams and creative NPD

Many organizations need to turn to the team based work systems to foster group innovation. Group creativity is not completely determined by individual creativity, but might emerge synergistically through members' interactions in a certain environment (Priola-Merlo and Mann, 2004). Virtual teams are rapidly growing as a vehicle to pull together the key human resources across the globe to respond and overcome the pressures and demands of our competitive global market place (Nemiro, 2004). They are defined as groups of individuals collaborating in the execution of a specific project while geographically dispersed, possibly beyond the boundaries of their parent organization (Lenders et al., 2003; Nemiro, 2004; Verburg and Bosch-Sijtsema, 2007). Communication and activities are carried out through IT technology – email, telephone, videoconferencing, etc. (Nemiro, 2002). These teams are deemed to have the capability to solve the most complex problems due to the diversity in skills and competences of their members (Prasad and Akhilesh, 2002).

Literature on NPD teams specifies that creativity, innovativeness and speed are important indicators of NPD effectiveness (Badrinarayanan and Arnett, 2008). In the context of virtual NPD teams decision quality and decision speed are the ones promoting faster learning and competence development, the incorporation of more advanced product ideas, faster decisions due to better problem solving and high quality solutions that lead to superior product quality (Athuahene-Gima, 2003). Combining the presented knowledge and the theoretical framework, our first hypothesis therefore presumes:

H1: Working in virtual teams has a direct positive effect on perceived NPD effectiveness.

Such teams are presumed to work faster, smarter, more creatively and more flexibly (Majchrzak et al., 2004). Since creativity requires loose settings, free spirits and a lack of strict boundaries (Leenders et al., 2007), such teams should foster creativity. And since in business organizations today

creativity and innovation are less often the product of individual genius and more often the outcome of processes in teams (Leenders et al., 2007), virtual team structures may actually lead to higher levels of team creativity. They open up possibilities for greater innovation because of more diverse participation and stimulate product and process creativity (Prasad and Akhilesh, 2002). We therefore hypothesize:

H2: Working in virtual teams has a positive effect on team creativity in NPD.

Furthermore, organizations involved in NPD have to adopt flexible, dispersed methods of working to meet the numerous and varied demands of the global marketplace (Tseng and Abdalla, 2006). Thus, virtual teams come together to perform a specific NPD task. As they are located in separate geographic areas, they heavily depend on IT technology to gather information and get feedback (Staples and Webster, 2007). Their NPD project meetings are therefore carefully structured and planned in order to ensure the highest effectiveness possible in this time. This also means that the design process is carefully planned and structured. With this notion, we hypothesize:

H3: Working in virtual teams has a positive effect on the structured design process.

Team Creativity in NPD

Creativity plays a decisive role in the process of idea generation and represents an important input into the NPD process (Duhovnik, 2003; Duhovnik and Balic, 2004; Duhovnik and Horvath, 2005). A creative output must be relevant, effective, appropriate, and offer a genuine solution to a particular problem or presented task (Nemiro, 2004). Creativity does not happen inside people's heads, but in interactions among team members. Team creativity can be defined as something more than a sum of interactions and individuals' creativity within the time given. Team creativity requires teams to combine and integrate input from multiple team members (Leenders et al., 2003). They also need to perceive creativity and working in a certain environment as vital for NPD in order to enable its positive effects.

The design process is defined as an innovative process, whereby the inputs into the process are creative ideas and the final result is a definition of the final product. It is an integral part of the NPD process as defined by Buijs (2003).

In the NPD process sufficient emphasis needs to be put on the first phase

– the strategy formulation. In this phase the strategic need for innovation is made explicit by estimating the future corporate situation when no strategic changes are made. Combining external opportunities and corporate strengths, results in possible search areas for the formulation of a design brief – the input into the design process. Once a decision on the new product has been made, the functions it should fulfil are defined and given a certain form. NPD process is then further evaluated and if the product suffices the criteria stated, it can be introduced to the market.

Each phase of the NPD process, therefore also the design process, requires specific knowledge and skills to assure a successful transition to the next phase, whereby creativity is essential to start it. It provides a critical point for a firm's performance in a complex and changing environment (Basadur and Hausdorf, 1996). In NPD creative performance is of preeminent importance (Leenders et al., 2007). We therefore hypothesize:

H4: Team creativity has a positive effect on the structured design process within the virtual environment.

The recognition and definition of the problem is an activity guided by an individual or group within a firm intending to identify a new business opportunity (Benedicic et al., 2006). The key activity in this process is idea generation, in which creativity plays a crucial role. As the NPD project progresses from the early conceptualization phase to the final commercialization phase, the design methods can become more systematic, which can lead to reduced creativity needs (Leenders et al., 2007). With regard to this notion we sub-hypothesize that the idea generation phase of the design process is the one most influenced by creativity.

As creativity is seen as one of the factors influencing the design process and its output, we consequently hypothesize:

H5: Team creativity within virtual environments has a positive effect on perceived NPD effectiveness level.

The phases of the design process

The design process is usually viewed as a logical, patterned sequence of steps or stages through which an individual or a team moves, to define, clarify, and work out a problem and then produce a solution to that problem (Nemiro, 2004). The essence of the design process is to represent the idea of a new function in the environment down to the smallest detail and build a product that satisfies this function in the end (Duhovnik and Tavcar, 2000). This process is similar in face-to-face and virtual NPD teams; however Nemiro

(2004) has found some intriguing differences (i.e. in virtual teams there is more of a push to get to development quickly). As this study is done on an example of virtual teams, we follow her definition of the design process. She (Nemiro, 2002; Nemiro, 2004) argues that virtual teams follow a path of four stages in the quest toward the production of creative results: idea generation, development, finalization and closure, and evaluation. The idea generation phase starts when an unmet need or an unsolved question is recognized and pursued by a team (Nemiro, 2004). After the starting efforts are drafted, presented and disseminated, an integrative stage of development follows. The team works to develop a product, project or service that meets the proposed needs. Once ideas are developed into workable outcomes, the created products are finalized and implemented (Nemiro, 2004). After implementation the evaluation phase concludes the design process. The team assesses the strengths and weaknesses of the completed project. It is crucial to realize that these stages may not be mutually exclusive and the activities can overlap and reoccur in another stage. However, the establishment of procedures and forums for team members is needed to clarify their goals, get feedback from one another and ensure accountability has an important role in final NPD success (Nemiro, 2004). On the basis of this notion, we hypothesize:

H6: A structured design process in virtual environments has a positive effect on perceived NPD effectiveness level.

To summarize the logic and causal relationships behind the proposed hypotheses: the main presumption is that in practice, NPD effectiveness needs to be enhanced in order to ensure firm's survival in the competitive market place. New technologies enable this, by enabling the formation of virtual teams that can work "outside the box" of the formal organization and therefore give more creative results. Consequently, the higher creativity gained through working in virtual environments can enhance the NPD result. Finally, both virtual team environment and creativity have a positive effect on the design process being performed, giving effect on the NPD effectiveness also indirectly through the more effective design process.

Research method

We will test the theoretical framework on an example of the EGPR 2011 course. We carried out a sample survey among the students participating in EGPR. The main focus of our study is to test the aspects on virtual teams formed in design courses. The goal of the study is to test the perceived effectiveness level of virtual teams in design education and how creativity is contributing to the final result. The obtained results are expected to give

an outline of the effectiveness of student virtual teams in NPD and future guidelines for such formations in design education and real environments. The same research has already been performed in 2008, 2009 and 2010 (for details see Fain and Kline, 2010). The aim of this paper is to benchmark the new results to the previous study in order to either confirm or reject the proposed theoretical framework. We are also aiming at identifying the major influences the Universities participating in EGPR need to consider in their educational process to enable effective knowledge on NPD for the students.

Overview of EGPR

In 2011, the University of Ljubljana, University of Zagreb, TU Budapest, EPFL Lausanne and City University London participated in the EGPR course. The main objective of the course was (and is) to teach the students NPD processes on a practical case within a virtual environment. The course is a 1 semester Masters course, combining lectures in NPD process and related issues and the practical NPD task.

In 2011, the project task was to develop a technologically and technically advanced Cycling interface for urban users.

The task demanded a creative and complete NPD approach of the students. The students did research in all participating countries, so that the results can be applied on a more general scale. They did extensive research to explore the market needs and the solutions already available on the market. With the user perspective analyzed they were able to see the user expectations and which other factors had to be involved in NPD to realize a result that is acceptable for the end user (Fain et al., 2007). To achieve their goal a structured design process was applied that involved the creative effort within a virtual NPD environment. The final result of the course, were 5 working prototypes that were developed in the final workshop where the participating student teams finally met face-to-face.

Data collection

To test our hypotheses we collected data from students that participated in the EGPR course in 2011. 36 participants out of 41 responded to the questionnaire, giving the effective response rate of 87,8%.

Questionnaire design

The questionnaire, designed to test the perception of EGPR students with regard to working in virtual teams, creativity, the design process and the NPD effectiveness, consists of items taken from well-established and

validated scales (Nemiro, 2004).The questionnaire has been modified according to findings of Fain et al. (2008). The pilot study has namely shown that several items used in the original questionnaire have not contributed significantly to the composite score of the latent variables and have therefore been left out. A repeated analysis of the previous research (Fain et al., 2008) with lesser items has produced similar results, thus confirming the argument presented. A shorter questionnaire has also proven to be more user-friendly and has produced a higher response rate.

With this in mind, the students assessed working in virtual environments by assessing (1) the degree to which the task of the project was effectively accomplished by virtual team design and (2) the effectiveness of team's integration of IT and face-to-face contact in leading to promising creative results.

To evaluate the design process employed during the EGPR course, the students were asked to indicate the mechanisms employed during the phases undertaken in the course. Since previous research has shown that the separate phases are highly correlated, meaning that the students perceive them as being in flux during their design process, we measured only the design process as a whole. The students so assessed whether there was (1) a disciplined procedure in place to scan the environment for unmet needs, (2) a forum that team members could use to share the ideas they found intriguing, (3) a not judgemental evaluation possible for the ideas presented, (4) a possibility of presenting the ideas to other team members and (5) a disciplined procedure for using specific criteria to evaluate alternative solutions, (6) adequate time set aside to make last minute adjustments and revisions before implementation, (7) a system in place for gaining agreement from individuals outside the team who might be affected by the proposed action and (8) an appropriate timeframe to reach closure on a particular creative effort. The students also assessed (9) the use of feedback after evaluation and (10) to what degree the project was parcelled out to individual team members.

To evaluate team creativity the students were asked (1) how often they utilized specific creative techniques for stimulating creativity and (2) how effective the overall creative process was.

Finally, to assess the effectiveness of the NPD process within the EGPR teams, the students were asked to rate how effective their teams' NPD phases were overall. They evaluated (1) the effectiveness of the idea generation phase, (2) the effectiveness of development phase and (3) the effectiveness of the finalization phase. Although Nemiro (2002; 2004) established there are four phases within the design process, the final evaluation phase was not included in the survey, as the students' work concluded before the actual production of the product and they therefore could not determine the effectiveness of the evaluation phase.

All the items were measured on 7-point scales. Each mechanism was given a composite score created by averaging the scores of the items.

Data analysis

To validate our hypotheses we utilized the structural equation modelling (SEM) for data analysis. We used the partial least squares (PLS) technique of SEM that utilizes a variance-based approach for estimation. We used SmartPLS 2.0 (Ringle et al 2005) for performing the analysis. Unlike covariance based packages, i.e. LISREL that employ χ^2 statistics, PLS uses R^2 statistics and does not place strict demands on sample size and data normality (Ifinedo et al 2010). Two assessments are supported by PLS: (1) the measurement model assessment, where item reliability, convergent and discriminant validities of the measurement scales are examined and (2) the structural model assessment, where information related to item loadings and the strength of the paths in models is presented. The path significance levels using t-values are estimated by the bootstrap method.

Assessment of the measurement model

Internal consistency is demonstrated when the reliability of each measure in a scale is above 0.7. The traditional criterion for internal consistency is Cronbach's Alpha, which provides an estimate for reliability based on the indicator inter-correlations (Henseler et al., 2009). As shown in table 1 we have however chosen to assess internal consistency by measuring composite reliability. Some researchers have namely suggested that composite reliability is similar to Cronbach's Alpha and can be interpreted in the same way (Ifinedo et al., 2010), but unlike Cronbach's Alpha, the composite reliability takes into account that the indicators have different loadings. All of the measured constructs have the composite reliability exceeding the recommended 0.7 indicating adequate internal consistency. Convergent validity is adequate if each of the constructs in the model has an average variance expected (AVE) of at least 0.5 (Fornell and Larcker, 1981). AVE measures the percentage of the overall variance for indicators represented in a latent construct through the ratio of the sum of the captured variance and the measurement error (Hair et al., 1998). It is further recommended that the factor loadings of all items should be above 0.6 for convergent validity to be demonstrated. The factor loadings are presented in the Appendix (table 2); all the items that have values lower than the recommended value of 0.6 are marked and have been excluded from further analysis.

Table 1: COMPOSITE RELIABILITY, AVE, INTER-CONSTRUCT CORRELATIONS AND THE SQUARE ROOT OF AVE

Construct	Composite reliability	AVE	1.	2.	3.	4.
1. Working in virtual teams	0.998	0.999	**0.999**			
2. Team creativity	0.743	0.602	-0.093	**0.775**		
3. Structured design process	0.842	0.573	0.248	0.571	**0.756**	
4. Percieved NPD effectiveness	0.851	0.656	0.226	0.695	0.713	**0.809**

Note: (1) the bold fonts in the leading diagonals are square roots of AVE; (2) off-diagonal elements are correlations among constructs.

For adequate discriminant validity it has been recommended that the following three conditions be met: (1) the square root of AVE of all constructs should be larger than all other cross-correlations; (2) all AVE should have values above 0.5; and (3) the principal component factor analysis should have item loadings greater than 0.6 on their respective constructs, and no item should load highly on any other construct (Fornell and Larcker,1981). The results in table 1 indicate that all correlations between constructs were lower than the squared root of AVE (the principal diagonal element) and all AVEs were above the 0.5 threshold. The SmartPLS confirmatory analysis also showed that all items loaded on the construct for which they were designed to measure. Thus, the discriminant validity of the scales used for this study is adequate.

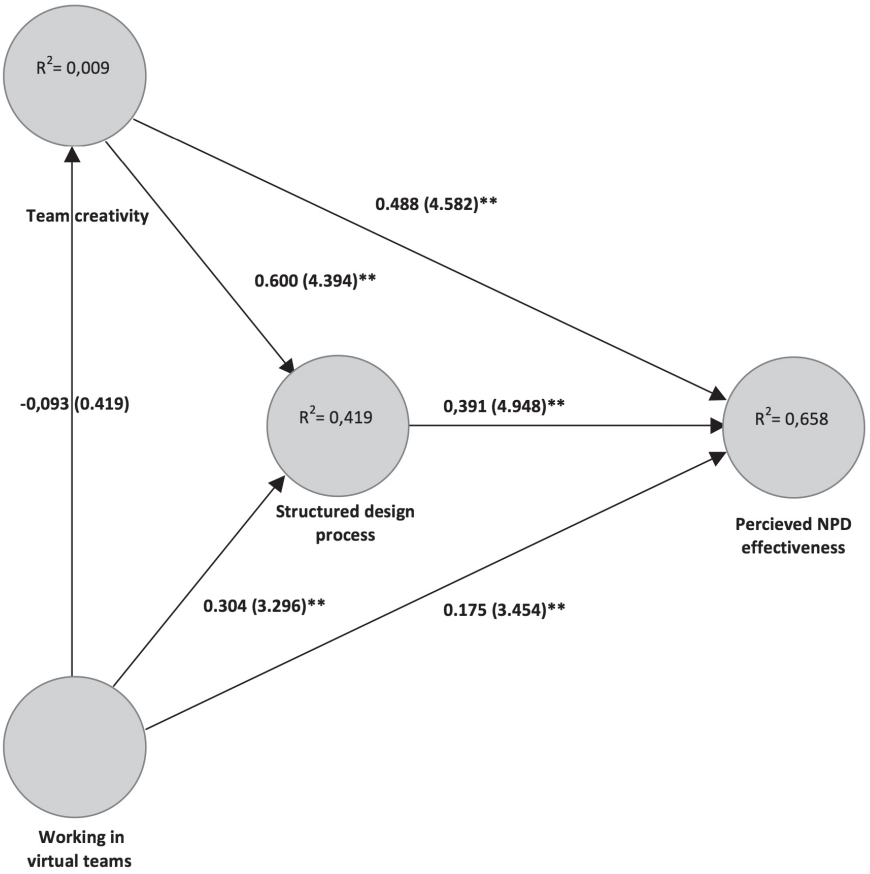
Assessment of the structural model

SmartPLS 2.0 provided the squared multiple correlations (R^2) for each construct in the model and path coefficients (β) with other constructs also given. The R^2 indicates the percentage of a construct's variance in the model, while path coefficients indicate the strength of relationships between constructs (Chin et al., 1996; Ringle et al., 2005). The results of the PLS analysis are shown in figure 2.

Five of our hypotheses were supported. Contrary to our prediction, we could not find statistical support for H2. Working in virtual teams was found not to have a significant effect on team creativity (β=-0,093; t=0.419). It did however have a positive effect on the structured design process (β=0,304; t=3.296), thus confirming our third hypothesis (H3). Similarly, creativity was found to have a strong effect on the structured design process (β=0,600; t=4.394), confirming H4. It has also proven to have a positive effect directly on the perceived NPD effectiveness (β=0,488; t=4.582), thus confirming our fifth hypothesis (H5). Similarly, working in virtual teams has a positive effect on the perceived NPD effectiveness (β=0,175; t=3.454), confirming H1. The

structured design process has also proven to have a significant effect on the perceived NPD effectiveness (β=0,391; t=4.948), giving confirmation to our final hypothesis (H6).

Figure 2: THE SMARTPLS RESULTS FOR THE TESTED HYPOTHESIZED PATHS



Discussion

Virtual teams have become a trend in NPD in the last ten years. They combine NPD specialists beyond the borders of their companies and even countries. The design process in such environments needs to be more structured, because virtual team members rarely have the chance for informal information exchange and feedback. In this way their communication is more focused. The NPD processes in such environments are also more dependent on the individual effort of the team members. However, due

to the dispersed locations, several broader views of the NPD task can be achieved. The team members can think and work "outside the box" and achieve higher NPD performance. In this way, creativity levels can also be raised.

These findings were put forward among others by Nemiro (2002; 2004) and have been essentially confirmed within the educational NPD environment that we tested. There was only one hypothesis derived from the model that we could not confirm – the effects of working in virtual teams on team creativity. Contrary to the EGPR study in previous years (for details see Fain and Kline, 2010; 2011), the students of EGPR 2011 see no connection between working in virtual teams and their team creativity. We search for explanation of these findings primarily in ways of socialization or enculturation of the EGPR team members during the project. These are processes through which participants learn about culturally accepted beliefs, values and behaviours, so they are able to act as effective members of the group (Schein, 1968; vanMannen and Schein, 1979). These processes are especially relevant and active for new members in an organization (Brown, 1998). With regard to these processes, our findings can be explained as a consequence of two factors. The first one is the absence of formal contents, lectures in the fields of creativity and functioning of teams in real as well as virtual environment within the EGPR course. The initiative related to the subject of working in virtual teams lies predominantly with the students. And second, there is limited possibility or even total absence of informal communication between the students, as most of the communication is mediated by information technology interfaces. Such interpretation can also be confirmed with the fact that the structure of the sample has changed in comparison to previous research (Fain and Kline, 2010). In the present sample there are no student representatives from TU Delft, which is the only University, where the students are given lectures on creativity and other "soft" factors in the process of innovation, design and development prior to the EGPR course. In accordance with this, the construct "Structured design process" in the model gains on importance. We can further attribute such a result to the domination of the respondents from national culture metaphorically named "Pyramid of people" (Hofstede, 2001; Fain and Kline, 2011). The main characteristics of such a culture include the tendency to follow formal rules and depend on collectivism, thus indicating a strong focus on structured processes within work.

Conclusions

In the 21st century global competition has grown to the level that the need for creativity, expertise and information has expanded beyond the

boundaries of individual organizations. The creation of virtual teams has developed as a response to the need for changes in design practice. Organizations today are faced with the need to search for talented individuals outside of their organizational boundaries in order to develop a competitive advantage based on innovation and innovative new products. Virtual teams are developing as the potentially new, optimal way to work and assist organizations in meeting the challenges of developing new products for the global market. Teaching the students such practice / skills can be efficient and beneficiary for their future design work. The presented research aimed at testing how creative NPD functions within virtual environments. The research was done on a design course carried out at five European Universities and the results show the perception of students with regard to the model put forward by Nemiro (2002; 2004). The model was supported, thus providing a framework for global teams putting forward global products in virtual environments. However, the specifics of the teams that were studied opened several important issues that still need to be addressed further.

As the results have shown, the students understand the structured design process and creativity to be the main attributes of the perceived NPD effectiveness. Surprisingly, they do not see working in virtual teams as relevant for their team creativity, but on the other hand they see working in virtual teams as a positive factor for their design process and final NPD result. Such results only indirectly support the thesis that virtual teams work well and produce more creative results. Why don't they understand their virtual teamwork to have relevance for team creativity is an important question that this research raises. We can search for explanation for this phenomenon in two ways: (1) there is a complete absence of student socialization and adaptation to the new working environment – virtual teams, or (2) the construct "working in virtual teams" needs to be reconsidered.

With regard to the problem of socialization, the EGPR staff would need to consider a reorganization of the course, especially in the sense of teaching the students the relevance and difference of working in virtual teams. The students regard the elements they know and understand as important, such as the structured design process phases, leaving out factors such as working in virtual teams. The pedagogical approach towards EGPR might therefore need some reconsideration.

Regarding the construct "working in virtual teams", some thought might need to be given to the way this construct is measured. Currently, the two items that measure the construct include the word "effective", which could guide the students towards a more positive perception of the NPD effectiveness. Additionally, less stress is given to the construct team creativity. This can lead to the lessened importance this construct is given in the final model.

Table 2: SUMMARY OF THE MEASUREMENT SCALES

Measurement item	Item loading
Working in virtual teams: Composite reliability = 0,998	
The project was effectively accomplished by virtual team design.	0.993
The team's integration of IT and face-to-face contact was effective in leading to promising creative results.	0.993
Creativity: Composite reliability = 0,78	
We utilized specific creative techniques for stimulating creativity.	0,628
Our overall creative process was effective.	0,907
Structured design process: Composite reliability = 0,81	
There was a disciplined procedure in place to scan the environment for unmet needs.	0,575*
There was a forum that team members could use to share the ideas they found intriguing.	0,721
There was a not judgemental evaluation possible for the ideas presented.	0,426*
There was a possibility of presenting the ideas to other team members.	0,798
There was a disciplined procedure for using specific criteria to evaluate alternative solutions.	0,653
There was adequate time set aside to make last minute adjustments and revisions before implementation,	0,251*
There was a system in place for gaining agreement from individuals outside the team who might be affected by the proposed action and	0,307*
There was an appropriate timeframe to reach closure on a particular creative effort.	0,308*
The feedback after evaluation vas useful.	0,772
The project was parcelled out to individual team members.	0,309*
Perceived NPD effectiveness: Composite reliability = 0,93	
The idea generation phase was effective.	0,786
The development phase was effective.	0,824
The finalization phase was effective.	0,819

Note: the measurement items market with asterisks (*) were dropped from subsequent analysis.

REFERENCES

Amabile, T. M. (1997): Motivating Creativity in Organizations: On Doing What You Love and Loving What You Do. California Management Review, 40 (1): 39–58.

Atuahene-Gima, K. (2003): The effects of centrifugal and centripetal forces on product development speed and quality: how does problem solving matter? Academy of Management Journal, 46 (3): 359–373.

Badrinarayanan, V. and Arnett D. B. (2008): Effective virtual new product development teams: an integrated framework. Journal of business and industrial marketing, 23 (4): 242–248.

Basadur, M. and Hausdorf P. A. (1996): Measuring Divergent Thinking Attitudes Related to Creative Problem Solving and Innovation Management, Creativity Research Journal, 9 (1): 21–32.

Benedičič, J., Duhovnik, J. and Žavbi R. (2006): How small and medium-sized companies can find new product opportunities. In: Proceedings of TMCE 2006, April 18–22. Ljubljana, 1117–1126.

Buijs, J. (2003): Modelling Product Innovation Processes, from Linear Logic to Circular Chaos. Creativity and Innovation Management, 12(2): 76–93.

Brown, A. (1988): Organizational Culure. London: Fin Time Pitman Publishing.

Chin, W. W., Marcolin, B. L. and Newsted, P. R. (1996): A Partial Least Square Latent Variable Modelling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and Voice Mail Emotion/Adoption Study. In: Proceedings of the 17th International Conference on Information Systems, December 16–18, Cleveland, Ohio, 21–41. Available at: http://disc-nt.cba.uh.edu/chin/icis96.pdf

Duhovnik, J. (2003): Techniques and methods for product development. In: Automatyzacja produkcji. Referaty plenarne isesyjne. #Tom. #1 / IV Wroclawskie sympozjum, Wroclaw, Oficyna Wydawnicza Politechniki Wroclawskiej, 93–101.

Duhovnik, J. and I. Horvath (2005): Towards a better understanding of the methodological characteristics of engineering design research. In: ASME 2005 International Design Engineering Technical Conferences and computers and Information in Engineering conference, 24–28 September 2005, Long Beach, USA.

Duhovnik, J. and S. Balič (2004): Detail Funcionality Analysis Using Design Golden Loop. In: 4th International Seminar and Workshop, EDIProD' 2004, 7–9 October, Rydzyna, Poland.

Duhovnik J. and Tavčar J. (2000): Elektronsko poslovanje in tehnični informacijski sistemi: PDMS – Product Data Management Systems. Ljubljana: Faculty of Mechanical Engineering.

Fain N. And Kline M. (2010): Zaznana uspešnost kreativnega razvoja izdelkov v virtualnih timih – primer mednarodne šole EGPR. /Perceived effectiveness of creative NPD in virtual teams – the case of European Global Product Realization/. AkademijaMM 10 (16): 25–36.

Fain, N. and Kline M. (2011): The dynamics of multicultural NPD teams in virtual environments. 2011. International Journal of Technology and Design Education. Dostopno preko; http://www.springerlink.com/content/b151487384t1t22l/fulltext.pdf

Fain, N., Kline M. and Duhovnik J. (2008): Creativity of virtual teams in innovation processes: The case of European Global Product Realization. In: Proceedings of R&D Management Conference, June 17–20. Ottawa, Canada.

Fain, N., Moes C.C.M., van Doorn E.C and Duhovnik J. (2007): A novel design education approach for professional global product realization. In: Proceedings of E&PDE 2008, September 4–5, Barcelona, Spain, 643–648.

Fornell, C. and Larcker D. F. (1981): Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. Journal of marketing, 18: 39–50.

Gaudes, A., Hamilton-Bogart B., Marsh S. and Robinson H. (2007): A Framework for Constructing Effective Virtual Teams. The Journal of E-working 1: 83–97.

Hair, J. F., Jr., Anderson, R. E., Thatham, R. L., and Black, W. C. (1998): Multivariate data analysis. Upper Saddle River, NJ: Prentice-Hall International, Inc.

Henseler, J., Ringle C. M. And Sinkovics R. R. (2009): The use of Partial Least Square Path Modeling in International Marketing. Advances in International Marketing, 20: 277–319.

Horvath, I. (2006): Design competence Development in an academic virtual Enterprise. Proceedings of IDETC/CIE 2006. September 10–13. Philadelphia, Pennsylvania, USA.

Horvath, I., Wiersma M., Duhovnik J. and Stroud I. (2004): Navigated active learning in an international academic virtual enterprise. European Journal of Engineering Education, 24 (9): 505–519.

Ifinedo, P., Rapp B., Ifinedo A. and Sundberg K. (2010): Relationships among ERP post-implementation success constructs: An analysis at the organizational level. Computers in human Behaviour, 26: 1136–1148.

Hofstede, G. (2001): Cultures Consequences, Sage Publications, Thousand Oaks.

Im, S. and J. P. Workman Jr. (2004): Market Orientation, Creativity, and New Product Performance in High-Technology Firms. Journal of Marketing, 68: 114–132.

Leenders, R. T. A. J., Van Engelen J. M. L. and Kratzer J. (2003): Virtuality, communication, and new product team creativity: a social network perspective. Journal of Engineering and Technology Management, 20: 69–92.

Leenders, R. T. A. J., van Engelen J. M. L. and Kratzer J. (2007): Systematic Design Methods and the Creative Performance of New Product Teams: Do They Contradict or Complement Each Other? Journal of Product Innovation Management, 24: 166–179.

Majchrzak, A., Malhotra A., Stamps J. and Lipnack J. (2004): Can absence make a team grow stronger? Harvard Business Review, 82 (5): 131–137

Martins, E. C. and Terblanche F. (2003): Building organizational culture that stimulates creativity and innovation. European Journal of Innovation Management, 6 (1): 64–74.

McAdam, R. and McClelland J. (2002): Individual and team-based idea generation within innovation management: organizational and research agendas. European Journal of Innovation Management, 5 (2): 86–97.

Nemiro, J. E. (2002): The Creative Process in Virtual Teams. Creativity Research journal 14 (1): 69–83.

Nemiro, J. E. (2004): Creativity in Virtual Teams: Key Components for Success. San Francisco: Pfeiffer.

Pirola-Merlo, A. and L. Mann (2004): The relationship between individual creativity and team creativity: aggregating across people and time. Journal of Organizational Behavior, 25: 235–257.

Prasad, K. and Akhilesh K. (2002): Global virtual teams: what impacts their design and performance. Team Performance Management 8: 102–112.

Ringle, C., Wende S. and Will A. (2005): SmartPLS Version 2.0 M3. Dostopno preko: www.smartpls.de.

Ross, L. (1977): The intuitive psychologist and his shortcomings: Distortions in the attribution process. In: L. Berkowitz (Ed.), Advances in Experimental Social Psychology, 10: 173–220.

Sarin, S. and Mcdermott S. (2003): The effect of team leader characteristics on learn-

ing, knowledge application, and performance of cross-functional new product development teams. Decision studies, 34 (4): 707–739.

Schein, E. (1968). Organizational socialization and the profession of management, Industrila Management Review, 9: 1015.

Staples, D. S. and Webster J. (2007): Exploring Traditional and Virtual Team members "Best Practices": A Social Cognitive Theory Perspective. Small Group Research, 38(1): 60–97.

Tseng, K. C. and Abdalla H. (2006): A novel approach to collaborative product design and development environment. In: Proceedings of the Institution of Mechanical Engineers, 220 (12): 1997–2020.

VanMaannen, J. and Shein E. (1979): Toward a theory of organizational socialization in B.M, Sraw and L. L. Cumming (Eds.) Research in Organizational Behavior, Vol. I. JAI Press, Greenwich.

Verburg, R. M. and Bosch-Sijtsema P. M. (2007): The limits of virtual work (guest editorial). The electronic Journal for Virtual Organizations and Networks, 9: 1–8.

Warkentin, M. E., Sayeed L. in Hightower R. (1997): Virtual teams versus face-to-face teams: An exploratory study of a Web-based conference system. Decision Sciences, 28 (4): 975–996.

Žavbi, R. and Tavčar J. (2005): Preparing undergraduate students for work in virtual product development teams. Computers & Education, 44 (4): 357–376.