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## VIRTUAL TEAMS FOR NEW PRODUCT DEVELOPMENT – AN INNOVATIVE EXPERIENCE FOR R&D ENGINEERS

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**Abstract :** *New interaction tools such as internet allows companies to gain valuable input from research and development (R&D) engineers via virtual teams. Consequently engineers also get more expertise in diminutive timeframes. Virtual R&D teams present the key impetus to the technology acquisition process. The present knowledge-economy era is characterized by short product life-cycles. Virtual R&D teams may reduce time-to-market, make available a large pool of new product know-how and provide greater flexibilities which are the key success factors in a competitive market. This comprehensive review contains almost 100 references and covers the recent literature with emphasis on topic. The review has focused on authentic and reputed publications and extracts the results. This article presents the type of virtual teams and their main features and explains how virtual R&D team can play a prominent role in developing new products. The article is evolved future study guideline and also illustrates how to apply virtual interaction tools and integrate engineers into the innovation process. Management of virtual R&D teams in new product development (NPD) processes in an innovative, effective and efficient is of a high importance, but the issue has been poorly addressed in the previous studies. Findings show that virtual R&D team provides valuable input for new product development and R&D engineers are able to attain virtual experience.*

**Keywords:** *Virtual R&D Teams, New Product Development, Virtual Experience, R&D Engineers*

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### INTRODUCTION

Information technology is providing the infrastructure necessary to support the development of new organizational forms. Virtual teams represent one such organizational form, one that could revolutionize the workplace and provide organizations with unprecedented levels of flexibility and responsiveness (Powell, Piccoli, & Ives, 2004). Virtual teams afford many advantages to organizations, including increased knowledge sharing (Pauleen, 2003) and employee job satisfaction and commitment, as well as improved organizational performance (Furst, Reeves, Rosen, & Blackburn, 2004). Virtual teams are believed to be an important element in future R&D organization (Gassmann & Von Zedtwitz, 2003). Many research and development (R&D) organizations and teams currently use a specialized knowledge portal for research collaboration and knowledge management (Lee, Kim, & Koh, 2009).

New product development (NPD) teams are integral components of firms that develop, manufacture, and sell technological offerings. Complex NPD tasks are difficult to solve, involving different functional departments, experience of engineers, judgment and tradeoffs (Enge, 2004). Given the complexities involved in organizing face-to-face interactions between team members and, leveraging the advancements in electronic communication technologies, firms are employing virtual teams in product development activities. Considering the lack of industrial experiences for engineering students, universities look for a suitable situation in which the students can perform a design project not limited to paper calculation. Virtual NPD team can be a solution to compensate the lack of industrial experience of engineer students.

This paper with a comprehensive review of literature and related resources covering the topic presents type of virtual teams, examples of uses of virtual team, and their benefits, draw back and main features and explains how virtual

R&D team can play a prominent role in developing new products. The article also illustrates NPD and its relationship with virtuality and elaborates different NPD process and finally team effective virtual team will also be discussed.

**Definition of Virtual Team**

Gassmann and Von Zedtwitz (2003) defined “virtual team as a group of people and sub-teams who interact through interdependent tasks guided by common purpose and work across links strengthened by information, communication, and transport technologies”. Another definition suggests that virtual teams, are distributed work teams whose members are geographically dispersed and coordinate their work predominantly with electronic information and communication technologies (e-mail, video-conferencing, telephone, etc.) (Hertel, Geister, & Konradt, 2005), different authors have identified diverse. Along with Bal and Teo (2001) it could be concluded that a team will become virtual if it meets four main common criteria and other characteristics that are summarized in Table 1. Geographically dispersed teams allow organizations to hire and retain the best people regardless of location. The temporary aspect of the team appears less emphasized (Lee-Kelley & Sankey, 2008) although (Bal & Teo, 2001; Paul, Seetharaman, Samarah, & Peter Mykytyn, 2005; Wong & Burton, 2000) included temporary in virtual team definition but some authors like Gassmann and Von Zedtwitz (2003) use may be temporary for some team members.

Table 1 Common criteria of virtual team

<b>Characteristics of virtual team</b>	<b>Descriptions</b>	<b>References</b>
Common criteria	1. Geographically dispersed (over different time zones)	(Dafoulas & Macaulay, 2002; Lee-Kelley & Sankey, 2008; Nemiro, 2002; Peters & Manz, 2007; Shin, 2005; Wong & Burton, 2000)
	2. Driven by common purpose( guided by a common purpose)	(Bal & Teo, 2001; Gassmann & Von Zedtwitz, 2003; Hertel et al., 2005; Rezgui, 2007; Shin, 2005)
	3. Enabled by communication technologies	(Bal & Teo, 2001; Lee-Kelley & Sankey, 2008; Nemiro, 2002; Peters & Manz, 2007)
	4. Involved in cross-boundary collaboration	(Bal & Teo, 2001; Gassmann & Von Zedtwitz, 2003; Precup, O'Sullivan, Cormican, & Dooley, 2006; Rezgui, 2007)
Other characteristics	1. It is not a permanent team	(Bal & Teo, 2001; W F Cascio & Shurygailo, 2003; Leenders, Engelen, & Kratzer, 2003; Paul et al., 2005; Wong & Burton, 2000)
	2. Small team size	(Bal & Teo, 2001)
	3. Team member are knowledge workers	(Bal & Teo, 2001; Kirkman, ROSEN, TESLUK, & GIBSON, 2004)
	4. Team members may belong to different companies	(Dafoulas & Macaulay, 2002; Leenders et al., 2003)

A summary of definition of virtual team may be taken as: small temporary groups of geographically, organizationally and/or time dispersed knowledge workers who coordinate their work predominantly with electronic information and communication technologies in order to accomplish one or more organization tasks (Ale Ebrahim, Ahmed, & Taha, 2009b).

### **Types of Virtual Team**

Generally, we can differentiate various forms of “virtual” work depending on the number of people involved and the degree of interaction between them. The first is “*telework*” (telecommuting) which is done partially or completely outside of the main company workplace with the aid of information and telecommunication services.” *Virtual groups*“ are composed of two or more teleworkers engaged in a lasting relationship, pursuing a common interest and each member reports to the same manager (Ahuja, Galletta, & Carley, 2003). In contrast, a “*virtual team*” exists when the members of a virtual group interact with each other in order to accomplish common goals. Finally, “*virtual communities*” are larger entities of distributed work in which members participate via the Internet, guided by common purposes, roles and norms. In contrast to virtual teams, virtual communities are not implemented within an organizational structure but are usually initiated by some of their members (Li, 2004). Examples of virtual communities are open source software projects (Hertel et al., 2005). Teleworking is viewed as an alternative way to organize work that involves the complete or partial use of ICT to enable workers to get access to their labor activities from different and remote locations (Martinez-Sanchez, Pérez-Pérez, de-Luis-Carnicer, & Vela-Jiménez, 2006). Telework provides cost savings to employees by eliminating time-consuming commutes to central offices and offers employees more flexibility to co-ordinate their work and family responsibilities (Johnson, Heimann, & O’Neill, 2001).

### **Examples of Uses of Virtual Team**

Working in today’s business world is like working in a world where the sun never sets. Rezgui (2007) investigates the effectiveness of virtual teams, and any other suitable form of virtual collaboration, in the construction sector, and explores the factors that influence their successful adoption. May and Carter (2001) in their case study of virtual team working in the European automotive industry have shown that enhanced communication and collaboration between geographically distributed engineers at automotive manufacturer and supplier sites make them get benefits are better quality, reduced costs and a reduction in the time-to-market (between 20% to 50%) for a new product vehicle. New product development (NPD) requires the collaboration of new product team members both within and outside the firm (Martinez-Sanchez et al., 2006; McDonough, Kahn, & Barczak, 2001; Ozer, 2000) and NPD teams are necessary in almost all businesses (Leenders et al., 2003). In addition, the pressure of globalization competition companies face increased pressures to build critical mass, reach new markets, and plug skill gaps, NPD efforts are increasingly being pursued across multiple nations through all forms of organizational arrangements (Cumings & Teng, 2003). Given the resulting differences in time zones and physical distances in such efforts, virtual NPD projects are receiving increasing attention (McDonough et al., 2001). The use of virtual teams for new product development is rapidly growing and organizations can be dependent on it to sustain competitive advantage (Taifi, 2007).

### **Benefits and Draw Back of Virtual Team**

The availability of a flexible and configurable base infrastructure is one of the main benefits of virtual teams (Ale Ebrahim, Ahmed, & Taha, 2009a). Virtual R&D teams which members do not work at the same time or place (Stoker, Looise, Fisscher, & De Jong, 2001) often face tight schedules and a need to start quickly and perform instantly (Munkvold & Zigurs, 2007). As a drawback, virtual teams are particularly vulnerable to mistrust, communication break downs, conflicts, and power struggles (Rosen, Furst, & Blackburn, 2007). On the other hand, virtual teams reduce time-to-market (May & Carter, 2001). Lead time or time to market has been generally admitted to be one of the most important keys for success in manufacturing companies (Sorli, Stokic, Gorostiza, & Campos, 2006). Table 2 summarizes some of the main advantages and

Table 3 some of the main disadvantages associated with virtual team. We are in a transient phase that is pushing out beyond the envelope of team fundamentals into a space where we begin to lose track of reality (Qureshi & Vogel, 2001). Clearly the rise of network technologies has made the use of virtual teams feasible (Beranek & Martz, 2005). Finally organizational and cultural barriers are another serious impediment to the effectiveness of virtual teams. Many managers are uncomfortable with the concept of a virtual team because successful management of virtual teams may require new methods of supervision (Jarvenpaa & Leidner, 1999).

Table 2: some of the main advantages associated with virtual team

<b>Advantages</b>	<b>Reference</b>
Reducing relocation time and costs, reduced travel costs (Virtual teams overcome the limitations of time, space, and organizational affiliation that traditional teams face (Piccoli, Powell, & Ives, 2004))	(Bergiel, Bergiel, & Balsmeier, 2008; Biuk-Aghai, 2003; Boudreau, Loch, Robey, & Straub, 1998; Wayne F. Cascio, 2000; Fuller, HARDIN, & DAVISON, 2006; Kankanhalli, Tan, & Wei, 2006; Lipnack & Stamps, 2000; Liu & Liu, 2007; McDonough et al., 2001; Olson-Buchanan, Rechner, Sanchez, & Schmidtke, 2007; Prasad & Akhilesh, 2002; Rice, Davidson1, Dannenhoffer, & Gay, 2007)
Reducing time-to-market [Time also has an almost 1:1 correlation with cost, so cost will likewise be reduced if the time-to-market is quicker (Rabelo & Jr., 2005)]	(T.-Y. Chen, 2008; Ge & Hu, 2008; Guniš, Šišlák, & Valčuha, 2007; Kankanhalli et al., 2006; Kusar, Duhovnik, Grum, & Starbek, 2004; Lipnack & Stamps, 2000; May & Carter, 2001; Mulebeke & Zheng, 2006; Prasad & Akhilesh, 2002; Shachaf, 2008; Sorli et al., 2006; Sridhar, Nath, Paul, & Kapur, 2007; Zhang, Shen, & Ghenniwa, 2004)
Able to tap selectively into center of excellence, using the best talent regardless of location	(Badrinarayanan & Arnett, 2008; Boudreau et al., 1998; Boutellier, Gassmann, Macho, & Roux, 1998; Wayne F. Cascio, 2000; Criscuolo, 2005; Fuller et al., 2006; Furst et al., 2004; Prasad & Akhilesh, 2002; Samarah, Paul, & Tadisina, 2007)
Greater degree of freedom to individuals involved with the development project	(Badrinarayanan & Arnett, 2008; Ojasalo, 2008; Prasad & Akhilesh, 2002)
Greater productivity, shorter development times	(McDonough et al., 2001; Mulebeke & Zheng, 2006)
Producing better outcomes and attract better employees, Generate the greatest competitive advantage from limited resources.	(T. Y. Chen, Chen, & Ch, 2008; Martins, Gilson, & Maynard, 2004; Rice et al., 2007)
Optimize the contributions of individual members toward the completion of business tasks and organizational goal	(Samarah et al., 2007)
Better team outcomes (quality, productivity, and satisfaction)	(Gaudes, Hamilton-Bogart, Marsh, & Robinson, 2007; Ortiz de Guinea, Webster, & Staples, 2005; Piccoli et al., 2004)
Higher team effectiveness and efficiency	(May & Carter, 2001; Shachaf & Hara, 2005)

Table 3: some of the main disadvantages associated with virtual team

<b>Disadvantages</b>	<b>References</b>
Decrease monitoring and control of activities	(Pawar & Sharifi, 1997)
Vulnerable to mistrust, communication break downs, conflicts, and power struggles	(Baskerville & Nandhakumar, 2007; Wayne F. Cascio, 2000; Kirkman, Rosen, Gibson, Tesluk, & McPherson, 2002; Rosen et al., 2007; Taifi, 2007)
Challenges of determining the appropriate task technology fit	(Badrinarayanan & Arnett, 2008; Bell & Kozlowski, 2002; Griffith, Sawyer, & Neale, 2003; Ocker & Fjermestad, 2008; Pawar & Sharifi, 2000; Qureshi & Vogel, 2001)
Cultural and functional diversity in virtual teams lead to differences in the members' thought processes. Develop trust among the members are challenging	(Badrinarayanan & Arnett, 2008; Bell & Kozlowski, 2002; Boutellier et al., 1998; Griffith et al., 2003; Jacobsa et al., 2005; Kankanhalli et al., 2006; Munkvold & Zigurs, 2007; Paul, Seetharaman, Samarah, & Peter Mykytyn, 2005 ; Poehler & Schumacher, 2007; Shachaf, 2005)
Sometimes requires complex technological applications	(Badrinarayanan & Arnett, 2008; Bergiel et al., 2008)

## **New Product Development**

Product development definition used by different researchers with slightly different ways but generally it is the process that covers product design, production system design and product introduction processes and start of production (Johansen, 2005). New product development (NPD) is widely recognized as a key to corporate prosperity (Lam, Chin, Yang, & Liang, 2007). The product life cycle of goods grows shorter every year. Today, leading-edge firms can exploit global asset configurations to customize existing products and services, and they also have the ability to combine their resources with an expanding knowledge base to create a continuous stream of new products and services (Miles, Snow, & Miles, 2000). With the needs to respond quickly to dynamic customer needs, increased complexity of product design and rapidly changing technologies, the selection of the right set of NPD is critical to a company's long-term success (H. H. Chen, Kang, Xing, Lee, & Tong, 2008). Also combination of factors such as ever changing market needs and expectations, rough competition and emerging technologies among others, challenges industrial companies to continuously increase the rate of new products to the market to fulfill all these requirements (Sorli et al., 2006). The ultimate objective of all NPD teams is superior marketplace success of the new product (Akgun, Lynn, & Yilmaz, 2006). In light of the above product innovations are central in securing a firm's competitive advantage in international markets (Jeong, 2003). NPD is vital and needs to be developed both innovatively and steadily (H. H. Chen et al., 2008).

### **NPD and virtuality**

New product development (NPD) has long been recognized as one of the corporate core functions (Huang, Soutar, & Brown, 2004). During the past 25 years NPD has increasingly been recognized as a critical factor in ensuring the continued existence of firms (Biemans, 2003). The rate of market and technological changes has accelerated in the past years and this turbulent environment requires new methods and techniques to bring successful new products to the marketplace (González & Palacios, 2002). Particularly for companies with short product life cycles, it is important to quickly and safely develop new products and new product platforms that fulfill reasonable demands on quality, performance, and cost (Ottosson, 2004). The world market requires short product development times (Starbek & Grum, 2002) therefore in order to successfully and efficiently get all the experience needed in developing new products and services, more and more organizations are forced to move from traditional face-to-face teams to virtual teams or adopt a combination between the two types of teams (Precup et al., 2006). Given the complexities involved in organizing face-to-face interactions among team members and the advancements in electronic communication technologies, firms are turning toward employing virtual NPD teams (Badrinarayanan & Arnett, 2008; Jacobsa et al., 2005; Schmidt, Montoya-Weiss, & Massey, 2001). New product development requires the collaboration of new product team members both within and outside the firm (Martinez-Sanchez et al., 2006; McDonough et al., 2001; Ozer, 2000) and NPD teams are necessary in almost all businesses (Leenders et al., 2003). In addition, the pressure of globalization competition companies face increased pressures to build critical mass, reach new markets, and plug skill gaps, NPD efforts are increasingly being pursued across multiple nations through all forms of organizational arrangements (Cummings & Teng, 2003). Given the resulting differences in time zones and physical distances in such efforts, virtual NPD projects are receiving increasing attention (McDonough et al., 2001). The use of virtual teams for new product development is rapidly growing and organizations can be dependent on it to sustain competitive advantage (Taifi, 2007).

### **New product development process**

Today's uncertain and dynamic environment presents a fundamental challenge to the new product development process of the future (MacCormack, Verganti, & Iansiti, 2001). New product development is a multi-dimensional process and involves multiple activities (Ozer, 2000). Several authors proposed different conceptual models for the NPD process, beginning from the idea screen and ending with the commercial launch. Kusar et al. (2004) summarized different stages of new product development which in earlier stages, the objective is to make a preliminary market, business, and technical assessment whereas at the later stages the propose is to actually Design and develop.

- 1- Definition of goals ( goals of the product development process)
- 2- Feasibility study ( term plan, financial plan, pre-calculation, goals of market)
- 3- Development ( first draft and structure of the product, first draft of components, product planning and its control processes)
- 4- Design ( design of components, drawing of parts, bills of material)

The model of Cooper Figure 1, called the Stage-Gate System is one of the most widely acknowledged system in NPD (Rejeb, Morel-Guimaraes, & Boly, 2008). The Stage-Gate System model divides the NPD into discrete stages, typically five stages. Each stage gathers a set of activities to be done by a multifunctional project team. To enter into each stage, some conditions and criteria have to be fulfilled. They are specified in the Gates. A Gate is a project review in which all the information is confronted by the whole team. Some criticism of the method has surfaced, claiming that the steering group assessment in the gate step halts the project for an unnecessarily long time, making the process abrupt and discontinuous (Ottosson, 2004). A closer integration of management through virtual team in the process might be a solution for avoiding such situations.

Stage-Gate process is a method of managing the new product development process to increase the probability of launching new products quickly and successfully. The process provides a blueprint to move projects through the different stages of development: idea generation, preliminary investigation, business case preparation, product development, product testing, and product introduction. This process is used by such companies as IBM, Procter & Gamble, 3M, General Motors, and others. The process is primarily used in the development of specific commercial products, and is more likely to be used in platform projects than in derivative projects.

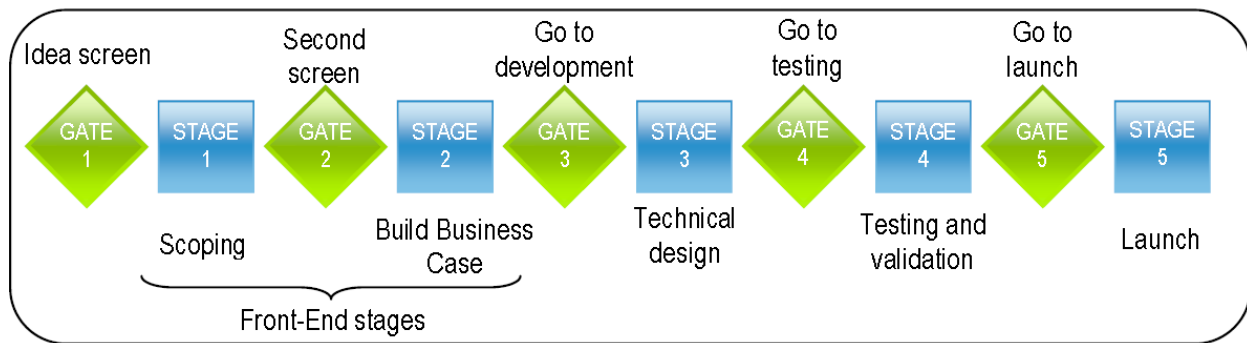


Figure 1 The Stage-Gate system model (source Cooper (2006))

*Development Stage-Gate System in NPD process:*

The new products plan will support the strategic objectives of the firm and make the best use of its strategic competencies. As it is illustrated in Figure 2, the development stages of the NPD process include the generation of new product ideas, the development of an initial product concept, an assessment of its business attractiveness, the actual development of the product, testing it within the market, and the actual launch of the product in the marketplace. Alongside each of these stages, an evaluation takes place, essentially to determine whether the new product should advance further or be terminated (Tzokas, Hultink, & Hart, 2004).

**Effective Virtual Team**

A review of the literature shows the factors that impact on the effectiveness of virtual teams are still ambiguous. Many of the acknowledged challenges of effective virtual team working, focus on ensuring good communication among all members of the distributed team (Anderson, McEwan, Bal, & Carletta, 2007). For example, Jarvenpaa and Leidner (1999) found that regular and timely communication feedback was key to building trust and commitment in distributed teams. Lin et al.(2008) study indicates that social dimensional factors need to be considered early on in the virtual team creation process and are critical to the effectiveness of the team. Communication is a tool that directly influences the social dimensions of the team and in addition the performance of the team has a positive impact on satisfaction with the virtual team.

For teams moving from co-location to virtual environments, an ability to adapt and change can be a long process riddled with trial and error scenarios. This process is seen as necessary to encourage effective virtual teams(Kirkman et al., 2002). Despite weak ties between virtual team members, ensuring lateral communication maybe adequate for effective virtual team performance. In terms of implementation, lateral communication in both virtual context and composition teams can be increased by reducing the hierarchical structure of the team (i.e. a flatter reporting

structure and/or decentralization) and the use of enabling computer-mediated communication tools(Wong & Burton, 2000).

Malhotra and Majchrzak's (2004)study of 54 effective virtual teams found that creating a state of shared understanding about goals and objectives, task requirements and interdependencies, roles and responsibilities, and member expertise had a positive effect on output quality. As criteria, effectiveness ratings were Hertel et al.(2005) collected from the team managers both at the individual and at the team level. The results of the field study showed good reliability of the task work-related attributes, teamwork-related attributes, and attributes related to tele-cooperative work.

Shachaf and Hara (2005)suggests four dimensions of effective virtual team leadership:

1. Communication (the leader provides continuous feedback, engages in regular and prompt communication, and clarifies tasks);
2. Understanding (the leader is sensitive to schedules of members, appreciates their opinions and suggestions, cares about member's problems, gets to know them, and expresses a personal interest in them);
3. Role clarity (the leader clearly defines responsibilities of all members, exercises authority, and mentors virtual team members); and
4. Leadership attitude (the leader is assertive yet not too "bossy," caring, relates to members at their own levels, and maintains a consistent attitude over the life of the project).



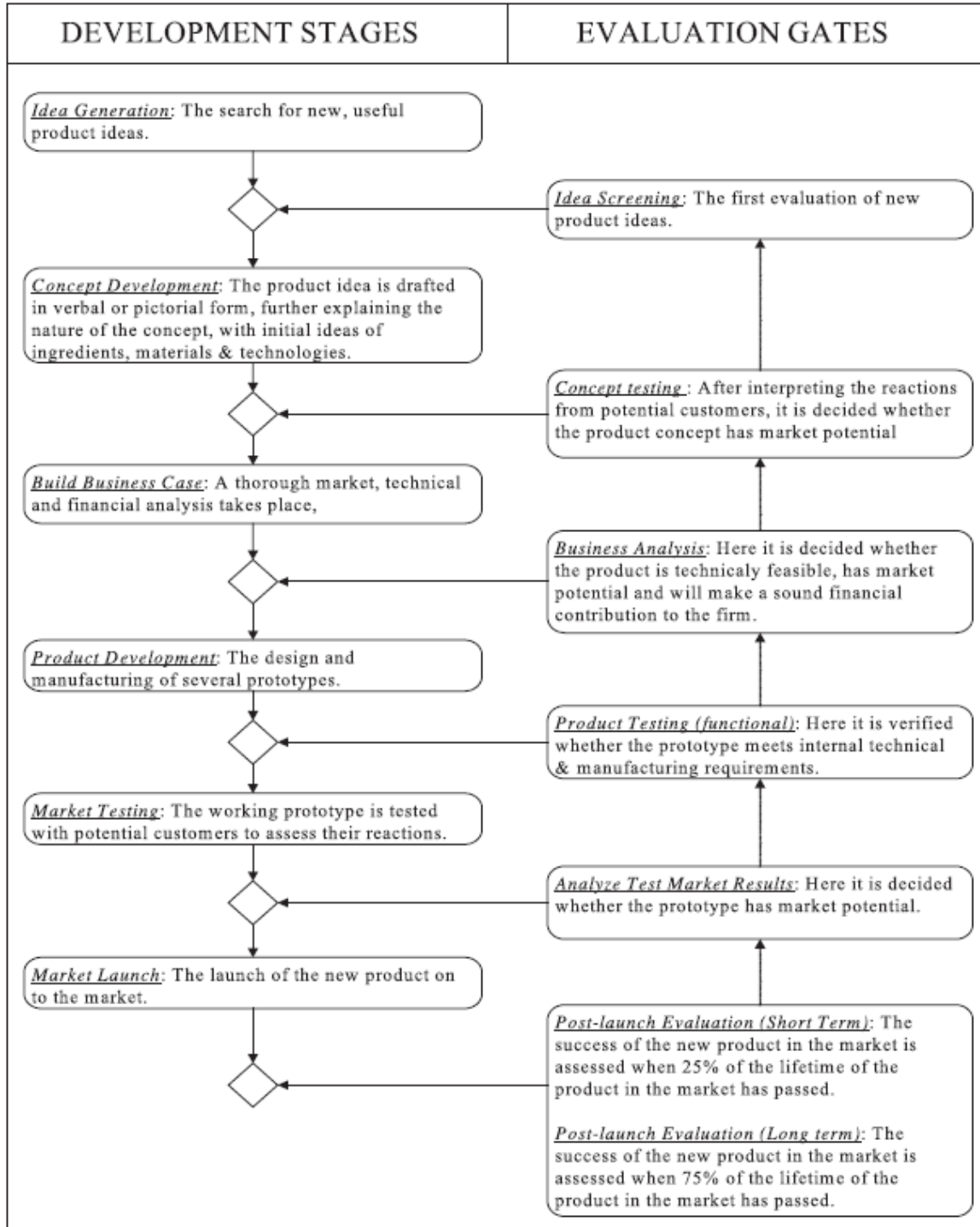


Figure 2 Development stages and evaluation gates in the NPD process ( Source: (Tzokas et al. (2004)).

### CONCLUSION

Competitive business environments and social pressures are driving the adoption of virtual team working. This paper with a comprehensive review of literature and related resources covering the topic, find that success in implementing virtual team working is more about processes and people than about technology. Organizations are

often naive about the advantages, problems and disadvantages of virtual team working. Virtual teams offer many benefits to organizations striving to handle a more demanding work environment, but also present many challenges and potential pitfalls. With comparing Table 2, with Table 3 it is clearly obvious that advantages of utilize virtual teams are far from its disadvantages so dealing with it can bring new findings. Virtual teams are a new and exciting work form with many fascinating opportunities. Due to these opportunities, virtual teamwork becomes increasingly popular in organizations and institutions. A suitable situation in which the students can perform a design project not only limited to paper calculation but also earn industrial experiences is working as a virtual NPD team member.

Future research would now seem to be essential for developing a comprehensive study, combining literature survey with case study in different size of companies (e.g. multinational companies and small and medium enterprises) and various type of activities (e.g. research and development and new product development). Such a study would provide an assessing what patterns, practices, or types of activities must virtual NPD teams carry out to achieve effectiveness in the competitive environment?, How such teams should be managed? What types of process structure and technology support should be provided for facilitating such teams?, What different methods of virtual team are uses today and how effective are they?, What benefits and problems arise as a consequence of the creation of virtual team? What is role of different collaborative technologies in supporting the virtual team? and How to make the transition from a more traditional team structure to the more distributed team structure?. These questions and many other practical questions wait for future empirical investigation.

## REFERENCES

- Ahuja, M. K., Galletta, D. F., & Carley, K. M. (2003). Individual Centrality and Performance in Virtual R&D Groups: An Empirical Study *Management Science*, 49(1), 21-38.
- Akgun, A. E., Lynn, G. S., & Yilmaz, C. (2006). Learning process in new product development teams and effects on product success: A socio-cognitive perspective. *Industrial Marketing Management*, 35, 210 – 224.
- Ale Ebrahim, N., Ahmed, S., & Taha, Z. (2009a). Innovation and R&D Activities in Virtual Team. [Literature review]. *European Journal of Scientific Research*, 34(3), 297-307.
- Ale Ebrahim, N., Ahmed, S., & Taha, Z. (2009b). Virtual Teams: a Literature Review. *Australian Journal of Basic and Applied Sciences*, Article in Press.
- Anderson, A. H., McEwan, R., Bal, J., & Carletta, J. (2007). Virtual team meetings: An analysis of communication and context. *Computers in Human Behavior*, 23, 2558–2580.
- Badrinarayanan, V., & Arnett, D. B. ( 2008). Effective virtual new product development teams: an integrated framework. [Conceptual paper]. *Journal of Business & Industrial Marketing*, 23(4), 242-248.
- Bal, J., & Teo, P. K. (2001). Implementing virtual teamworking. Part 1: a literature review of best practice. [Research paper]. *Logistics Information Management*, 13(6), 346 - 352.
- Baskerville, R., & Nandhakumar, J. (2007). Activating and Perpetuating Virtual Teams: Now That We're Mobile, Where Do We Go? *IEEE Transactions on Professional Communication*, 50(1), 17 - 34
- Bell, B. S., & Kozlowski, S. W. J. (2002). A Typology of Virtual Teams: Implications for Effective Leadership. *Group and Organization Management*, 27(1), 14-49.
- Beranek, P. M., & Martz, B. (2005). Making virtual teams more effective: improving relational links. [ Research article ]. *Team Performance Management*, 11(5-6), 200-213.
- Bergiel, J. B., Bergiel, E. B., & Balsmeier, P. W. (2008). Nature of virtual teams: a summary of their advantages and disadvantages. [Conceptual paper]. *Management Research News*, 31(2), 99-110.

- Biemans, W. G. (2003). A picture paints a thousand numbers: a critical look at b2b product development research [General review]. *Business & Industrial Marketing*, 18(6/7), 514-528.
- Biuk-Aghai, R. P. (2003). *Patterns of Virtual Collaboration*. University of Technology, Sydney.
- Boudreau, M.-C., Loch, K. D., Robey, D., & Straub, D. (1998). Going Global: Using Information Technology to Advance the Competitiveness Of the Virtual Transnational Organization. *Academy of Management Executive*, 12(4), 120-128.
- Boutellier, R., Gassmann, O., Macho, H., & Roux, M. (1998). Management of dispersed product development teams: The role of information technologies. *R&D Management*, 28(13-25).
- Cascio, W. F. (2000). Managing a virtual workplace. *The Academy of Management Executive*, 14(3), 81-90.
- Cascio, W. F., & Shurygailo, S. (2003). E-Leadership and Virtual Teams. *Organizational Dynamics*, 31(4), 362-376.
- Chen, H. H., Kang, Y. K., Xing, X., Lee, A. H. I., & Tong, Y. (2008). Developing new products with knowledge management methods and process development management in a network. *Computers in Industry*, 59, 242-253.
- Chen, T.-Y. (2008). Knowledge sharing in virtual enterprises via an ontology-based access control approach. *Computers in Industry, Article In press*, No of Pages 18.
- Chen, T. Y., Chen, Y. M., & Ch, H. C. (2008). Developing a trust evaluation method between co-workers in virtual project team for enabling resource sharing and collaboration. *Computers in Industry* 59(6), 565-579.
- Cooper, R. G. (2006). Managing Technology Development Projects. *Research Technology Management*, 49(6), 23-31.
- Criscuolo, P. (2005). On the road again: Researcher mobility inside the R&D network. *Research Policy*, 34, 1350-1365
- Cummings, J. L., & Teng, B. S. (2003). Transferring R&D knowledge: the key factors affecting knowledge transfer success. *Journal of Engineering Technology Management*(20), 39-68.
- Dafoulas, G., & Macaulay, L. (2002). Investigating Cultural Differences in Virtual Software Teams. *The Electronic Journal of Information Systems in Developing Countries (EJISDC)*, 7(4), 1-14.
- Enge, R. (2004). *An explorative study of knowledge transfer processes in new product development in the automotive industry*.
- Fuller, M. A., HARDIN, A. M., & DAVISON, R. M. (2006). Efficacy in Technology-Mediated Distributed Team *Journal of Management Information Systems*, 23(3), 209-235.
- Furst, S. A., Reeves, M., Rosen, B., & Blackburn, R. S. (2004). Managing the life cycle of virtual teams. *Academy of Management Executive*, 18(2), 6-20.
- Gassmann, O., & Von Zedtwitz, M. (2003). Trends and determinants of managing virtual R&D teams. *R&D Management* 33(3), 243-262.
- Gaudes, A., Hamilton-Bogart, B., Marsh, S., & Robinson, H. (2007). A Framework for Constructing Effective Virtual Teams *The Journal of E-working* 1(2), 83-97
- Ge, Z., & Hu, Q. (2008). Collaboration in R&D activities: Firm-specific decisions. *European Journal of Operational Research* 185, 864-883.

- González, F. J. M., & Palacios, T. M. B. (2002). The effect of new product development techniques on new product success in Spanish firms. *Industrial Marketing Management* 31(3), 261-271.
- Griffith, T. L., Sawyer, J. E., & Neale, M. A. (2003). Virtualness and Knowledge in Teams: Managing the Love Triangle in Organizations, Individuals, and Information Technology. [General\_Information]. *MIS Quarterly*, 27(2), 265-287.
- Guniš, A., Šišlák, J., & Valčuha, Š. (2007). Implementation Of Collaboration Model Within SME's. In P. F. Cunha & P. G. Maropoulos (Eds.), *Digital Enterprise Technology-Perspectives and Future Challenges* (pp. 377-384 ): Springer US.
- Hertel, G. T., Geister, S., & Konradt, U. (2005). Managing virtual teams: A review of current empirical research. *Human Resource Management Review*, 15, 69–95.
- Huang, X., Soutar, G. N., & Brown, A. (2004). Measuring new product success: an empirical investigation of Australian SMEs. *Industrial Marketing Management*, 33, 117– 123.
- Jacobsa, J., Moll, J. v., Krause, P., Kusters, R., Trienekens, J., & Brombacher, A. (2005). Exploring defect causes in products developed by virtual teams *Information and Software Technology*, 47(6), 399-410.
- Jarvenpaa, S. L., & Leidner, D. E. (1999). Communication and Trust in Global Virtual Teams. *Organization Science* 10(6), 791 - 815
- Jeong, I. (2003). A cross-national study of the relationship between international diversification and new product performance. *International Marketing Review*, 20(4), 353-376.
- Johansen, K. (2005). *Collaborative Product Introduction within Extended Enterprises*. Linköpings Universitet, Linköping, Sweden.
- Johnson, P., Heimann, V., & O'Neill, K. (2001). The “wonderland” of virtual teams. *Journal of Workplace Learning*, 13(1), 24 - 30.
- Kankanhalli, A., Tan, B. C. Y., & Wei, K.-K. (2006). Conflict and Performance in Global Virtual Teams. *Journal of Management Information Systems*, 23(3), 237-274.
- Kirkman, B. L., Rosen, B., Gibson, C. B., Tesluk, P. E., & McPherson, S. O. (2002). Five challenges to virtual team success: lessons from Sabre Inc. *Academy of Management Executive*, 16(3), 67-79.
- Kirkman, B. L., ROSEN, B., TESLUK, P. E., & GIBSON, C. B. (2004). THE IMPACT OF TEAM EMPOWERMENT ON VIRTUAL TEAM PERFORMANCE: THE MODERATING ROLE OF FACE-TO-FACE INTERACTION. *Academy of Management Journal*, 47(2), 175-192.
- Kusar, J., Duhovnik, J., Grum, J., & Starbek, M. (2004). How to reduce new product development time. *Robotics and Computer-Integrated Manufacturing* 20, 1-15.
- Lam, P.-K., Chin, K.-S., Yang, J.-B., & Liang, W. (2007). Self-assessment of conflict management in client-supplier collaborative new product development. [Research paper]. *Industrial Management & Data Systems*, 107(5), 688 - 714.
- Lee-Kelley, L., & Sankey, T. (2008). Global virtual teams for value creation and project success: A case study. *International Journal of Project Management* 26, 51–62.
- Lee, H. J., Kim, J. W., & Koh, J. (2009). A contingent approach on knowledge portal design for R&D teams: Relative importance of knowledge portal functionalities. *Expert Systems with Applications*, 36(2, Part 2), 3662-3670.

- Leenders, R. T. A. J., Engelen, J. M. L. V., & Kratzer, J. (2003). Virtuality, communication, and new product team creativity: a social network perspective. *Journal of Engineering and Technology Management, 20*, 69–92.
- Li, H. (2004). *Virtual Community Studies: A Literature Review, Synthesis and Research Agenda*. Paper presented at the Proceedings of the Americas Conference on Information Systems. from <http://aisel.aisnet.org/amcis2004/324>
- Lin, C., Standing, C., & Liu, Y.-C. (2008). A model to develop effective virtual teams. *Decision Support Systems, 45*(4), 1031-1045.
- Lipnack, J., & Stamps, J. (2000). Why The Way to Work. In *Virtual Teams: People Working across Boundaries with Technology* (Second Edition ed., pp. 1-25). New York: John Wiley & Sons.
- Liu, B., & Liu, S. (2007). *Value Chain Coordination with Contracts for Virtual R&D Alliance Towards Service*. Paper presented at the The 3rd IEEE International Conference on Wireless Communications, Networking and Mobile Computing, WiCom 2007. from [http://ieeexplore.ieee.org/xpls/abs\\_all.jsp?arnumber=4340609](http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4340609)
- MacCormack, A., Verganti, R., & Iansiti, M. (2001). Developing Products on "Internet Time": The Anatomy of a Flexible Development Process. *MANAGEMENT SCIENCE, 47*(1), 133-150.
- Malhotra, A., & Majchrzak, A. (2004). Enabling knowledge creation in far-flung teams: best practices for IT support and knowledge sharing. *Journal of Knowledge Management, 8*(4), 75 - 88.
- Martinez-Sanchez, A., Pérez-Pérez, M., de-Luis-Carnicer, P., & Vela-Jiménez, M. J. (2006). Teleworking and new product development. [Technical paper]. *European Journal of Innovation Management, 9*(2), 202-214.
- Martins, L. L., Gilson, L. L., & Maynard, M. T. (2004). Virtual teams: What do we know and where do we go from here? *Journal of Management, 30*(6), 805–835.
- May, A., & Carter, C. (2001). A case study of virtual team working in the European automotive industry. *International Journal of Industrial Ergonomics, 27*, 171-186.
- McDonough, E. F., Kahn, K. B., & Barczak, G. (2001). An investigation of the use of global, virtual, and collocated new product development teams. *The Journal of Product Innovation Management, 18*(2), 110–120.
- Miles, R. E., Snow, C. C., & Miles, G. (2000). TheFuture.org *Long Range Planning, 33*(3), 300-321.
- Mulebeke, J. A. W., & Zheng, L. (2006). Incorporating integrated product development with technology road mapping for dynamism and innovation. *International Journal of Product Development 3*(1), 56 - 76.
- Munkvold, B. E., & Zigurs, I. (2007). Process and technology challenges in swift-starting virtual teams. *Information & Management, 44*(3), 287–299.
- Nemiro, J. E. (2002). The Creative Process in Virtual Teams *Creativity Research Journal, 14*(1), 69 - 83.
- Ocker, R. J., & Fjermestad, J. (2008). Communication differences in virtual design teams: findings from a multi-method analysis of high and low performing experimental teams. *The DATA BASE for Advances in Information Systems, 39*(1), 51-67.
- Ojasalo, J. (2008). Management of innovation networks: a case study of different approaches. *European Journal of Innovation Management, 11*(1), 51-86.
- Olson-Buchanan, J. B., Rechner, P. L., Sanchez, R. J., & Schmidtke, J. M. (2007). Utilizing virtual teams in a management principles course. [Case study]. *Education + Training, 49*(5), 408-423.

- Ortiz de Guinea, A., Webster, J., & Staples, S. (2005, October 12, 2005). *A Meta-Analysis of the Virtual Teams Literature*. Paper presented at the Symposium on High Performance Professional Teams Industrial Relations Centre, School of Policy Studies, Queen's University, Kingston, Canada.
- Ottosson, S. (2004). Dynamic product development -- DPD. *Technovation*, 24(3), 207-217.
- Ozer, M. (2000). Information Technology and New Product Development Opportunities and Pitfalls. [Research article]. *Industrial Marketing Management* 29(5), 387-396.
- Paul, S., Seetharaman, P., Samarah, I., & Peter Mykytyn, J. (2005, January 3-6,). *Understanding Conflict in Virtual Teams: An Experimental Investigation using Content Analysis*. Paper presented at the 38th Hawaii International Conference on System Sciences, Hawaii.
- Paul, S., Seetharaman, P., Samarah, I., & Peter Mykytyn, J. (2005 January 3-6,). *Understanding Conflict in Virtual Teams: An Experimental Investigation using Content Analysis*. Paper presented at the 38th Hawaii International Conference on System Sciences, Hawaii.
- Pauleen, D. J. (2003). An Inductively Derived Model of Leader-Initiated Relationship Building with Virtual Team Members. *Journal of Management Information Systems*, 20(3), 227-256.
- Pawar, K. S., & Sharifi, S. (1997). Physical or virtual team collocation: Does it matter? *International Journal of Production Economics* 52, 283-290.
- Pawar, K. S., & Sharifi, S. (2000). Virtual collocation of design teams: coordinating for speed. [General review]. *International Journal of Agile Management Systems*, 2(2), 104 - 113.
- Peters, L. M., & Manz, C. C. (2007). Identifying antecedents of virtual team collaboration. *Team Performance Management*, 13(3/4), 117-129.
- Piccoli, G., Powell, A., & Ives, B. (2004). Virtual teams: team control structure, work processes, and team effectiveness. [Research Paper]. *Information Technology & People*, 17(4), 359 - 379.
- Poehler, L., & Schumacher, T. (2007). *The Virtual Team Challenge: Is It Time for Training?* Paper presented at the PICMET 2007. from <http://ieeexplore.ieee.org/iel5/4349300/4349301/04349552.pdf?tp=&isnumber=&arnumber=4349552>
- Powell, A., Piccoli, G., & Ives, B. (2004). Virtual teams: a review of current literature and directions for future research. *The Data base for Advances in Information Systems*, 35(1), 6-36.
- Prasad, K., & Akhilesh, K. B. (2002). Global virtual teams: what impacts their design and performance? [Research paper]. *Team Performance Management*, 8(5/6), 102 - 112.
- Precup, L., O'Sullivan, D., Cormican, K., & Dooley, L. (2006). Virtual team environment for collaborative research projects. *International Journal of Innovation and Learning*, 3(1), 77 - 94
- Qureshi, S., & Vogel, D. (2001). Adaptiveness in Virtual Teams: Organisational Challenges and Research Directions. *Group Decision and Negotiation* 10(1), 27-46
- Rabelo, L., & Jr., T. H. S. (2005). Sustaining growth in the modern enterprise: A case study. *Journal of Engineering and Technology Management JET-M*, 22 274-290.
- Rejeb, H. B., Morel-Guimaraes, L., & Boly, V. (2008). *A new methodology based on Kano Model for needs evaluation and innovative concepts comparison during the front-end phases*. Paper presented at the The Third European Conference on Management of Technology, EUROMOT 2008. from [http://webintec.ceram.fr/euromot2008/conftool/uploads/310/1-Euromot\\_paper\\_Ben\\_Rejeb.pdf](http://webintec.ceram.fr/euromot2008/conftool/uploads/310/1-Euromot_paper_Ben_Rejeb.pdf)

- Rezgui, Y. (2007). Exploring virtual team-working effectiveness in the construction sector. *Interacting with Computers*, 19, 96–112.
- Rice, D. J., Davidson, B. D., Dannenhoffer, J. F., & Gay, G. K. (2007). Improving the Effectiveness of Virtual Teams by Adapting Team Processes. *Computer Supported Cooperative Work*, 16, 567–594.
- Rosen, B., Furst, S., & Blackburn, R. (2007). Overcoming Barriers to Knowledge Sharing in Virtual Teams. *Organizational Dynamics*, 36(3), 259–273.
- Samarah, I., Paul, S., & Tadisina, S. (2007). *Collaboration Technology Support for Knowledge Conversion in Virtual Teams: A Theoretical Perspective*. Paper presented at the 40th Hawaii International Conference on System Sciences (HICSS), Hawaii.
- Schmidt, J. B., Montoya-Weiss, M. M., & Massey, A. P. (2001). New product development decision-making effectiveness: Comparing individuals, face-to-face teams, and virtual teams. *Decision Sciences*, 32(4), 1-26.
- Shachaf, P. (2005). Bridging cultural diversity through e-mail. [Journal Article (Paginated) ]. *Journal of Global Information Technology Management*, 8(2), 46-60.
- Shachaf, P. (2008). Cultural diversity and information and communication technology impacts on global virtual teams: An exploratory study. *Information & Management*, 45(2), 131-142.
- Shachaf, P., & Hara, N. (2005). Team Effectiveness in Virtual Environments: An Ecological Approach. In P. a. G. Ferris, S., (Ed.), *Teaching and Learning with Virtual Teams* (pp. 83-108): Idea Group Publishing.
- Shin, Y. (2005). Conflict Resolution in Virtual Teams. *Organizational Dynamics*, 34(4), 331-345.
- Sorli, M., Stokic, D., Gorostiza, A., & Campos, A. (2006). Managing product/process knowledge in the concurrent/simultaneous enterprise environment. *Robotics and Computer-Integrated Manufacturing*, 22, 399–408.
- Sridhar, V., Nath, D., Paul, R., & Kapur, K. (2007). *Analyzing Factors that Affect Performance of Global Virtual Teams*. Paper presented at the Second International Conference on Management of Globally Distributed Work from <http://www.globalwork.in/gdw07/pdf/14-159-170.pdf>
- Starbek, M., & Grum, J. (2002). Concurrent engineering in small companies. *International Journal of Machine Tools and Manufacture*, 42(3), 417-426.
- Stoker, J. I., Looise, J. C., Fisscher, O. A. M., & De Jong, R. D. (2001). Leadership and innovation: relations between leadership, individual characteristics and the functioning of R&D teams. *The International Journal of Human Resource Management*, 12(7), 1141 – 1151.
- Taifi, N. (2007). *Organizational Collaborative Model of Small and Medium Enterprises in the Extended Enterprise Era: Lessons to Learn from a Large Automotive Company and its dealers' Network*. Paper presented at the Proceedings of the 2nd PROLEARN Doctoral Consortium on Technology Enhanced Learning, in the 2nd European Conference on Technology Enhanced Learning. from <http://ftp.informatik.rwth-aachen.de/Publications/CEUR-WS/Vol-288/p08.pdf>
- Tzokas, N., Hultink, E. J., & Hart, S. (2004). Navigating the new product development process. *Industrial Marketing Management*, 33(7), 619- 626.
- Wong, S. S., & Burton, R. M. (2000). Virtual Teams: What are their Characteristics, and Impact on Team Performance? *Computational & Mathematical Organization Theory*, 6(4), 339-360.

Zhang, S., Shen, W., & Ghenniwa, H. (2004). A review of Internet-based product information sharing and visualization. *Computers in Industry* 54(1), 1-15.