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# Benefits and Pitfalls of Virtual R&D Teams: An Empirical Study

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## Abstract

In this paper, advantages and drawbacks of virtual teams in research and development (R&D) are studied. With the globalization of commercial practices and advances in information and communication technologies, increasing numbers of enterprises are establishing cross-functional, geographically distributed virtual teams. Virtual teams in R&D are designed to access external resources and knowledge to maximize the competitive advantage from limited labor and resources. A survey has been conducted on 210 Malaysian and Iranian manufacturing companies, aimed to investigate the characteristics of R&D collaborations and extract the main advantages/disadvantages' factors of virtual teams. These factors can be a guide line for R&D manager to achieve better performance of virtual teams.

## Keywords

Virtual teams, Research and Developments, Survey finding

## 1. INTRODUCTION

An increasing number of companies, especially those with knowledge-intensive research and development (R&D) programs, have turned to virtual teams in recent years to generate the greatest competitive advantage from limited labor and resources [1]. The bulk of our understanding of teams is based on traditional teams in which all members are collocated and communicate face to face. However, geographically distributed teams, whose members are not collocated and must often communicate via technology, are growing in prevalence [2]. Meet the technological needs of industry and boost entity international competitiveness, companies should rely on operates a virtual teams R&D. These needs are fundamentally linked with the flow of information, assignment of competency, and transfer of authority in international R&D organization, and are central for international technology and knowledge transfer between dispersed R&D sites [3]. The mega trends like globalization and high demand fluctuation force companies and supply chains to innovate new business models to gain and maintain in a competitive position. Networking, outsourcing, and information and communication technology is considered as general tools and means to respond to these challenges [4]. As consequence multinational corporations (MNCs) have increased their research and development (R&D) investment in foreign countries [5].

Virtual teams are important mechanisms for organizations seeking to leverage scarce resources across

geographic and other boundaries. Moreover, virtual collaboration has become vital for most organizations. This is particularly true in the context of R&D activities. Such collaboration often involves a network of partners located around the world. However, at the R&D project level, dealing with such distributed teams challenged both managers and specialists. They should be aware of advantages and pitfalls of virtual teams in R&D. The decision to use a virtual team is often a necessity and not a choice; being 'virtual' is in most cases not a strategy but an operational reality [6]. Virtual teams reduce time-to-market and based on some evidence collaboration between geographically distributed teams sites yield some mutual benefits in terms of better quality and reduced costs between 20 to 50 percent for a new product [7]. Despite numerous studies on the topic in recent years, there still appears the need to a vision what virtual teams in R&D are and how it can impact the competitive advantage of enterprises.

In this paper, the following aspects, comprehensive definition of virtual teams, benefits and pitfalls of virtual teams, research method, data collection, data Analysis, discussions and finally Conclusion are covered. Details of pertinent practical guidelines and implications for R&D managers are also derived.

## 2. DEFINITION OF VIRTUAL TEAMS

Literature related to virtual teams revealed a lack of depth in the definitions. Although virtual teamwork is a current topic in the literature on global organizations, it has been

problematic to define what ‘virtual teams’ means across multiple institutional contexts [8]. The concept of a “team” is described as a small number of people with complementary skills who are equally committed to common purpose, goals, and working approach for which they hold themselves mutually accountable [9]. It is worth mentioning that virtual teams are often formed to overcome geographical or temporal separations [10]. Virtual teams work across boundaries of time and space by utilizing modern computer-driven technologies. The term “virtual teams” are used to cover a wide range of activities and forms of technology-supported working [11]. Gassmann and Von Zedtwitz [6] 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.) [12]. From the perspective of Leenders et al. [13] virtual teams are groups of individuals collaborating in the execution of a specific project while geographically and often temporally distributed, possibly anywhere within (and beyond) their parent organization. So we define virtual teams 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 [14, 15].

### 3. BENEFITS AND PITFALLS OF VIRTUAL TEAM

Working in today’s business world is like working in a world where the sun never sets. During the last decade, words such as “virtual”, “virtualization”, “virtualized” have been very often advocated by scholars and practitioners [16]. However, the advantages and pitfalls of virtual teams are concealed. The availability of a flexible and configurable base infrastructure is one of the main advantages of virtual teams. Virtual R&D teams often face tight schedules and a need to start quickly and perform instantly [17]. Virtual team may allow people to collaborate more productivity at a distance [18]. As a drawback, virtual teams are particularly weak to mistrust, communication break downs, conflicts, and power struggles [19]. On the other hand, virtual teams reduce time-to-market [7]. Lead Time or Time to market has been generally admitted to be one of the most important keys for success in manufacturing companies [20]. Clearly the rise of network technologies has made the use of virtual teams feasible [21]. Many managers are uncomfortable with the concept of a virtual team because

successful management of virtual teams may require new methods of supervision [22]. We provide a comprehensive point of view on virtual teams for such managers.

Forming and performing in virtual teams is useful for projects that require cross-functional or cross boundary skilled inputs and the key to their value creation is to have a defined strategy in place to overcome the issues highlighted, especially the time zones and cultural issues. While communication could be seen as a traditional team issue, the problem is magnified by distance, cultural diversity and language or accent difficulties. For migration or similar large-scale projects, personal project management competency, appropriate use of technology and networking ability, willingness for self-management, cultural and interpersonal awareness is fundamentals of a successful virtual team [23]. Thomas and Bostrom [24] found that a technology facilitator role can be critically important to virtual team success.

### 4. RESEARCH METHOD

A survey was developed to collect the data. A likert scale from 1 to 5 was used. This set up gave respondents a series of attitude dimensions. For each dimension, the respondent was asked whether, and how strongly, they agree or disagree to each dimension using a point rating scale. First the survey was tested in a small group and then modified and improve reliability for large samples. Participants were directed to a website and the survey was completed on-line. The rapid expansion of Internet users has given web-based surveys the potential to become a powerful tool in survey research [25]. Denscombe [26] findings encourage social researchers to use web-based questionnaires with confidence and the data produced by web-based questionnaires is equivalent to that produced by paper-based questionnaires. Other authors emphasized that the data provided by Internet methods are of at least as good quality as those provided by traditional paper-and-pencil methods [27, 28]. However minor differences occur between the two survey methods; online respondents provide more improvement suggestions [28] and tended to be slightly longer than those from the paper version, the differences are not statistically significant [29].

An online questionnaire was designed base on main advantages and disadvantages of virtual teams. 21 and 6 questions derived from literature review regarding benefits and pitfalls of virtual teams respectively. To help disentangle the concepts of virtual teams in R&D, 27 individual criteria asked from respondents (Table 1). These criteria have been grouped together through factor analysis to form the main advantages and disadvantages factors of virtual teams in R&D. The respondent asked a series of questions such as BEN1:

“How much did you benefit from using virtual teams on the scale of 1 to five (one being no benefit and 5 being the most benefit): Reduce time to market?”. The same procedures have implemented on the 6 disadvantages (DIS) factors of virtual teams (Table 2).

## 5. DATA COLLECTION

A total of 210 surveys were completed. However, after data cleansing procedures were applied, 125 surveys were available for analysis. Data cleansing has done according to usage of virtual teams in the firm. All respondents were asked to complete a web based questionnaire describing their organization, current position and their experiences with virtual teams. With Likert five scales measuring individual opinion about virtual teams' benefits and pitfalls in the questionnaire. Participants included individuals working on a variety of manufacturing companies. Industries included Automotive/vehicle and components 40%, Electronic products and components 15%, Home appliances 8%, Fabricated metal products and Electrical machinery, 5% each, and Paper products, Chemical products, Industrial equipment, almost has the same share in the rest portion.

Table 1 21 Criteria of The Virtual Teams Benefits

Question	Criteria	Question	Criteria
BEN1	Reduce time to market	BEN12	More effective R&D
BEN2	Increase team flexibility	BEN13	Using the best talent regardless of location
BEN3	Reduce design time	BEN14	Greater productivity
BEN4	shorter development times	BEN15	Producing better outcomes and attract better employees
BEN5	Cost saving	BEN16	Provide organizations with unprecedented level of flexibility
BEN6	Better operational efficiency	BEN17	Response quickly to changing business environments
BEN7	Better quantity information	BEN18	Sharing knowledge, experiences
BEN8	Increase coordination between departments	BEN19	Cultivating and managing creativity
BEN9	Increase coordination with suppliers/ customers	BEN20	Provide a vehicle for global collaboration and coordination of R&D related activities
BEN10	Reducing relocation time	BEN21	Facilitate knowledge capture
BEN11	Reduce travel costs		

Table 2 Six criteria of the virtual teams' pitfalls

Question	Criteria	Question	Criteria
DIS1	Challenges of determining the appropriate task technology fit	DIS4	Developing trust among the members are challenging
DIS2	Decreases monitoring and control of activities	DIS5	Cultural and functional diversity caused low efficiency of team
DIS3	Challenges of managing conflict	DIS6	Hidden cost is high

The main sampling target was managing director, R&D manager, a new product development manager, project and design manager and appropriate person who were most familiar with the R&D activities in the firm. For better understanding the questionnaire has been prepared into different languages English and Persian. The Iranian respondents could select either English version or Persian version of the questionnaire. 963 emails have sent to relevant manufacturing companies and requested them clicked the hyperlink of online web page and answer the questionnaire. Out of 963 respondents 210 manufacturing companies responded completely and the rest answered partially. Only 125 firms were met the criteria of this research so the rest of responded deducted from data analysis.

## 6. DATA ANALYSIS AND DISCUSSIONS

In the case of reliability analysis, Cronbach's Alpha [30] was employed to measure internal consistency of the 21 advantages factors of virtual teams. A reliability test was carried out to ensure that the research finding have the ability to provide consistence results. Cronbach's alpha for the 21 advantages factors were found within acceptable limits and to be 0.950, which means there was a high reliability for designed questions. An exploratory factor analysis was conducted on 21 advantages factors of virtual teams. Using a Principle Component Analysis with a Varimax Rotation and an Eigenvalue of 1 as the cut-off point [31] and an absolute value of a factor loading greater than 0.5 [32]. The 21 factors were grouped into four, which had an Eigenvalue greater than one. Furthermore, an exploratory factor analysis was conducted on six disadvantages factors of virtual teams. Only one component extracted, which mean all of six criteria have the same level of priority in R&D department of manufacturing companies.

The authors attempted to identify and named the confirmed factors based on the principle of being concise without losing clarity of meaning. After extracting the factors, Variables with higher loadings are considered more important and have greater influence on the name of

selected reduced factors. The names and contents of four derived factors are:

- Factor 1: It consists of “Better operational efficiency”, “Better quantity information”, “Greater productivity”, “Sharing knowledge, experiences”, “Provide organizations with unprecedented level of flexibility” and “Producing better outcomes and attract better employees” is named “Better Output”.
- Factor 2: It consists of “Reduce time to market”, “Reduce travel costs”, “Reduce design time”, “shorter development times”, “Cost saving”, “Reducing relocation time” and “Increase team flexibility”. Due to the fact that BEN4 has been higher loading (0.762) the factor is named “Reduce R&D time”.
- Factor 3: It consists of “More effective R&D”, “Using the best talent regardless of location”, “Response quickly to changing business environments”, “Facilitate knowledge capture”, “Provide a vehicle for global collaboration and coordination of R&D related activities” and “Cultivating and managing creativity” is named “More effective R&D”.
- Factor 4: It consists of “Increase coordination between departments” and “Increase coordination with suppliers/ customers” is named “Increase coordination”.

All above mentioned factors are summarized in Figure 1. This new model is based on data analysis of survey findings. The model provides an overview of virtual team advantages in manufacturing firms R&D of selected developing countries. Although more than 59 percent of respondents are working in manufacturing firms R&D on virtual teams bases but virtual team application in manufacturing companies is still in infancy.

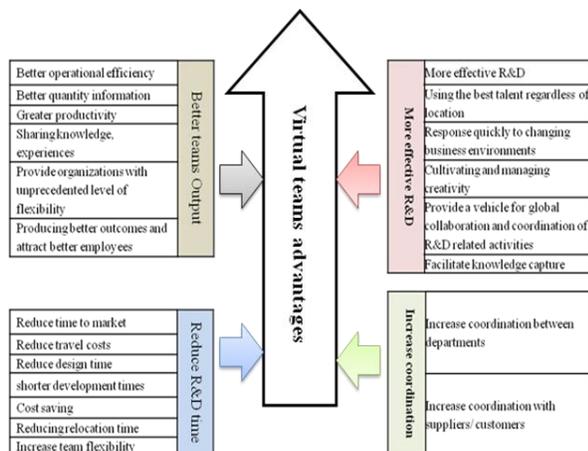


Figure 1. Model of main factors of virtual team advantages in manufacturing firms R&D (based on research results).

## 7. CONCLUSION

Factor Analysis provides direct insight into the interrelationships between 21 variables and reduced to four components. First factor which is consists of “Better operational efficiency”, “Better quantity information”, “Greater productivity”, “Sharing knowledge, experiences”, “Provide organizations with unprecedented level of flexibility” and “Producing better outcomes and attract better employees”, is more important than the rest three factors. So if managers of firms in developing countries looking for “better teams out put” they should employ virtual teams in R&D.

Despite the enormous benefaction of employ virtual teams in R&D department of manufacturing companies and virtual publicity, the application of virtual teams by most enterprises, is still at its infancy. While reviewing the previous study has believed and survey results are shown, we can conclude that the advantages of working based on virtual teams far outweigh the disadvantages. Virtual teams bring about better team output, reduce time-to-market, reduced travel costs, ability to tap selectively into a center of excellence, using the best talent regardless of location, greater degree of freedom to individuals, shorter development times, respond quickly to changing business environments, and finally higher team effectiveness and coordination. Therefore, the decision on setting up virtual teams is not a choice but a necessity. On the other hand, the manager of a virtual team should be aware of pitfalls of such a team which mostly vulnerable to mistrust, challenges of managing conflict, and decreases monitoring and control of activities.

This study is probably the first to present an empirical study on virtual teams in R&D in selected developing countries. The future research needs to investigate the model and verify it by a larger sample from different sectors since this study was limited to manufacturing sector. In a larger sample, it is possible to compare the results between different countries.

## REFERENCES

- [1] T. Y. Chen, Y. M. Chen, and H. C. Ch, "Developing a trust evaluation method between co-workers in virtual project team for enabling resource sharing and collaboration," *Computers in Industry* vol. 59, pp. 565-579, 2008.
- [2] P. J. Hinds and D. E. Bailey, "Out of Sight, Out of Sync: Understanding Conflict in Distributed Teams," *Organization Science*, vol. 14, pp. 615-632, 2003.
- [3] M. von Zedtwitz, O. Gassmann, and R. Boutellier, "Organizing global R&D: challenges and dilemmas," *Journal of International Management*, vol. 10, pp. 21-49, 2004.
- [4] E. Salmela and A. Lukka, "Value added logistics in supply and demand chains SMILE. Part 1 : Ebusiness between global company and its local SME supplier

- network, Research Report 153, ISBN 951-764-925-8," 2004.
- [5] G. Reger, "Coordinating globally dispersed research centers of excellence—the case of Philips Electronics," *Journal of International Management*, vol. 10, pp. 51–76, 2004.
- [6] O. Gassmann and M. Von Zedtwitz, "Trends and determinants of managing virtual R&D teams," *R&D Management* vol. 33, pp. 243-262, 2003.
- [7] A. May and C. Carter, "A case study of virtual team working in the European automotive industry," *International Journal of Industrial Ergonomics*, vol. 27, pp. 171-186, 2001.
- [8] K. M. Chudoba, E. Wynn, M. Lu, Watson-Manheim, and M. Beth, "How virtual are we? Measuring virtuality and understanding its impact in a global organization," *Information Systems Journal*, vol. 15, pp. 279-306, 2005.
- [9] M. M. N. Zenun, G. Loureiro, and C. S. Araujo, "The Effects of Teams' Co-location on Project Performance," in *Complex Systems Concurrent Engineering-Collaboration, Technology Innovation and Sustainability*, G. Loureiro and R. Curran, Eds. London: Springer, 2007, pp. 717-726.
- [10] W. F. Cascio and S. Shurygailo, "E-Leadership and Virtual Teams," *Organizational Dynamics*, vol. 31, pp. 362-376, 2003.
- [11] A. H. Anderson, R. McEwan, J. Bal, and J. Carletta, "Virtual team meetings: An analysis of communication and context," *Computers in Human Behavior*, vol. 23, pp. 2558–2580, 2007.
- [12] G. T. Hertel, S. Geister, and U. Konradt, "Managing virtual teams: A review of current empirical research," *Human Resource Management Review*, vol. 15, pp. 69–95, 2005.
- [13] R. T. A. J. Leenders, J. M. L. V. Engelen, and J. Kratzer, "Virtuality, communication, and new product team creativity: a social network perspective," *Journal of Engineering and Technology Management*, vol. 20, pp. 69–92, 2003.
- [14] N. Ale Ebrahim, S. Ahmed, and Z. Taha, "Virtual Teams: a Literature Review," *Australian Journal of Basic and Applied Sciences*, vol. 3, pp. 2653-2669, 2009.
- [15] N. Ale Ebrahim, S. Ahmed, and Z. Taha, "Virtual R & D teams in small and medium enterprises: A literature review," *Scientific Research and Essay*, vol. 4, pp. 1575–1590, December, 2009 2009.
- [16] A. Vaccaro, F. Veloso, and S. Brusoni, "The Impact of Virtual Technologies on Organizational Knowledge Creation: An Empirical Study," in *Hawaii International Conference on System Sciences: Proceedings of the 41st Annual Publication 2008*, pp. 352-352.
- [17] B. E. Munkvold and I. Zigurs, "Process and technology challenges in swift-starting virtual teams," *Information & Management*, vol. 44, pp. 287–299, 2007.
- [18] O. Gassmann and M. Von Zedtwitz, *Innovation Processes in Transnational Corporations*: Elsevier Science Ltd, 2003.
- [19] B. Rosen, S. Furst, and R. Blackburn, "Overcoming Barriers to Knowledge Sharing in Virtual Teams," *Organizational Dynamics*, vol. 36, pp. 259–273, 2007.
- [20] M. Sorli, D. Stokic, A. Gorostiza, and A. Campos, "Managing product/process knowledge in the concurrent/simultaneous enterprise environment," *Robotics and Computer-Integrated Manufacturing*, vol. 22, pp. 399–408, 2006.
- [21] P. M. Beranek and B. Martz, "Making virtual teams more effective: improving relational links," *Team Performance Management*, vol. 11, pp. 200-213, 2005.
- [22] S. L. Jarvenpaa and D. E. Leidner, "Communication and Trust in Global Virtual Teams," *Organization Science* vol. 10, pp. 791 - 815 1999.
- [23] L. Lee-Kelley and T. Sankey, "Global virtual teams for value creation and project success: A case study," *International Journal of Project Management* vol. 26, pp. 51–62, 2008.
- [24] D. M. Thomas and R. P. Bostrom, "Virtual Team Leader as Technology Facilitator: the missing role," in *Proceedings of the 2005 Southern Association for Information Systems Conference*, 2005, pp. 35-40.
- [25] S. J. Sills and C. Song, "Innovations in Survey Research: An Application of Web-Based Surveys," *Social Science Computer Review*, vol. 20, pp. 22-30, February 1, 2002 2002.
- [26] M. Denscombe, "Web-Based Questionnaires and the Mode Effect: An Evaluation Based on Completion Rates and Data Contents of Near-Identical Questionnaires Delivered in Different Modes," *Social Science Computer Review*, vol. 24, pp. 246-254, May 1, 2006 2006.
- [27] S. D. Gosling, S. Vazire, S. Srivastava, and O. P. John, "Should We Trust Web-Based Studies? A Comparative Analysis of Six Preconceptions About Internet Questionnaires," *American Psychologist*, vol. 59, pp. 93-104, 2004.
- [28] E. Deutskens, K. de Ruyter, and M. Wetzels, "An assessment of equivalence between online and mail surveys in service research," *Journal of Service Research*, vol. 8, pp. 346-355, May 2006.
- [29] M. Denscombe, "The Length of Responses to Open-Ended Questions: A Comparison of Online and Paper Questionnaires in Terms of a Mode Effect," *Social Science Computer Review*, vol. 26, pp. 359-368, August 1, 2008 2008.
- [30] L. Cronbach, "Coefficient alpha and the internal structure of tests," *Psychometrika*, vol. 16, pp. 297-334, 1951.
- [31] A. E. Akgün, M. Dayan, and A. D. Benedetto, "New product development team intelligence: Antecedents and consequences " *Information & Management* vol. 45, pp. 221-226, 2008.
- [32] M. Fathian, P. Akhavan, and M. Hoorali, "E-readiness assessment of non-profit ICT SMEs in a developing country: The case of Iran," *Technovation*, vol. 28, pp. 578-590, 2008.