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DIFFERENCES IN THE PERFORMANCE OF KNOWLEDGE TRANSFER ACROSS PROJECTS: A STUDY OF GENDER AND ROLE OF KEY PROJECT STAKEHOLDERS

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Abstract
This investigation contributes empirical results of differences identified in key project stakeholders with respect to their use of knowledge transferred across projects. Gender and role were the two individual characteristics investigated. Project managers and members of project teams were the key stakeholders analyzed. Data was collected from 71 closed projects using a survey composed of closed-ended questions. The data collected was cross tabulated and statistically analyzed using Friedman's test and Spearman's correlation. The results provide evidence of the association of the performance of knowledge transfer across projects with (a) the individual factors of gender and role of key project stakeholders in projects, and (b) the project factor of importance of the project deliverables to the project-based organization. These results are important to engineering management researchers and practitioners because they provide evidence of the importance of considering individual and project factors in the enhancement, design, and operation of knowledge management systems in project-based organizations.

Key Words: Knowledge Transfer, Project Management, Knowledge Management, Project-based organizations

Introduction

Organizations have devoted attention to initiatives commonly known as organizational learning (Huber, 1991) and knowledge management (Davenport and Prusak, 1998) to generate the ability to promote meaningful learning and sustainability by managing useful and usable knowledge. This learning ability is the result of organizational capabilities that support the life cycle of knowledge management systems (Davenport, et al., 2003; Voepel, et al., 2005). A knowledge management system (KMS) can be defined using two perspectives: the technical and the socio-technical perspectives. The technical perspective defines a KMS as being technology-centered. The socio-technical perspective defines a KMS as being more people-centered than technology-centered (Carayanis, 1998; Meso and Smith, 2000). The contributions that a KMS can bring to the performance and capabilities of an organization are many (Wenger, et al., 2002; Yeo, 2003; Yeung, et al. 1998) and are mediated and moderated by the characteristics of the organization (Agarwal, et al., 2004; Gittelman and Kogut, 2003; Paik & Choi, 2005; Syed-Ikhsan & Rowland, 2004).

A KMS enables organizations to continuously identify, create, enhance, transfer, share, assimilate, store, organize, verify, validate, protect, and apply useful an usable knowledge (Alavi and Leidner, 1999; Landaeta and Kotnour, 2005). A knowledge management system influences an organization through its outputs, but also through the formal and informal arrangements of its operations (Wenger, et al., 2002). The perceived success of KMSs has not been extensive in organizations due in part to the difficulties of representing knowledge (Boland, et al., 2001), measuring knowledge (Ahn and Chang, 2004; Berman, et al. 2002; Glazer, 1998), differentiating knowledge from information (McDermott, 1999), and the different challenges faced during the life cycle of knowledge management systems (Davenport, et al. 1998; Davenport, et al., 2003; Dixon, 2000)

KMSs possess a high number of elements (e.g., knowledge processes, communication technologies, individuals' and group motivation) that are critical (i.e., affect the capabilities and performance of the system), that continuously change throughout time, and that are interrelated to other elements of the knowledge management system and of the organization through different types of relationships (e.g., formal, indirect) that also change throughout time (Hansen, 1999; Davenport and Prusak, 1998). Consequently, KMSs are unique to organizations and are difficult to design, implement, operate, and enhance. In despite of these and other challenges, we have observed how organizations have devoted attention to the design, implementation, and enhancement of KMSs; in particular, systems that focus on providing knowledge transfer capabilities (Dixon 2000; Landaeta et al., 2006; Leonard & Kiron, 2002; Maya, et al. 2005; Paik & Choi, 2005).

In despite of these efforts, the current body of knowledge management and learning in the project environment lacks of empirical investigations that study the effects that gender and roles of project actors

have upon the use of knowledge from other projects, specially, in projects that are critical for the project-based organization. Consequently, we focus this investigation on the research questions: to what extent does the performance of knowledge transfer across projects is associated with the role and gender of key project stakeholders? To what extent are there gender and role differences in the use of knowledge obtained from other projects to solve problems in projects that deliver critical results to the project-based organization? Our answers of these research questions are expected to generate a better understanding of the complexities, challenges, and opportunities of KMSs.

In the first sections of this work we discuss knowledge transfer in projects. Later, we define and test a set of exploratory hypotheses to help us answer our research questions. We conclude by identifying implications of the results for project managers and knowledge managers in project-based organizations.

Knowledge transfer in the project environment

Kerzner (2005) defines a project as a series of activities and tasks that have a specific objective to be completed within certain performance specifications (e.g., quality); have limited resources (e.g., budget); have defined start and end dates; have a project manager and a project team with the authority and responsibility over the accomplishment of the project objectives; and have knowledge needs (Kerzner, 2005). Knowledge is needed in projects due to the uncertainty and ambiguity that characterize project's operations during the project life cycle (Hallgreen and Maaninen-Olsson, 2005). It is the nature of projects and particularly of R&D projects (Cummings and Teng, 2003). A lack of key knowledge in a project means that the project is not fully capable to accomplish its objectives without facing issues, problems, and even crisis (Hallgreen and Maaninen-Olsson, 2005). Landaeta (2008) suggest that projects need three general types of knowledge: knowledge to perform planned tasks, knowledge to resolve problems and crisis, and knowledge to continuously improve project operations. Therefore, a lack of knowledge capability in projects may generate projects' failure and challenges, both at the project and at the organizational level. For example, Repeninning and colleagues (2001) explain the emergence and persistence of firefighting in project-based organizations as a consequence of a lack of capabilities in projects. Accordingly, project stakeholders and senior managers of project-based organizations must strive to make projects more capable by eradicating uncertainty and by reducing ambiguity through the implementation of strategies that support knowledge transfer across projects. The premise is that knowledge that is needed in a project may already exist in another project across the project-based organization (Dixon, 2000; Kotnour, 1999). Consequently, project-based organizations need to design, deploy, operate, enhance, and sustain KMSs that are focused on knowledge transfer.

In project-based organizations knowledge is transferred from a source project to a project recipient through a network of formal and informal, direct and indirect relationships (Bresnen et al., 2003; Hansen, 2002; Sense, 2003). Hansen (2002) explains the project knowledge network as direct and indirect relationships that exist between projects that have related knowledge (i.e., potential project sources and recipients of knowledge).

Several factors that affect the performance and capabilities of knowledge transfer within and across projects have been empirically identified by researchers, examples of these include: knowledge distance (Cummings and Tengs, 2001), the knowledge transfer processes and tools (Dixon, 2000; Cummings and Tengs, 2001), the perceived need for knowledge (Newell, 2004), the organizational culture (Karlsen and Gottschalk, 2004), the capacity to absorb knowledge (Newel, 2004), the size of the organization (Love et al., 2003), the stress to contribute to project performance (Garrick and Clegg, 2001), politics (Sense, 2003), and laws and technical regulations (Brochner, 2004).

Recently, Eskerod and Skriven (2007) suggested that although the feminine values suggested by Hosfstede (1980) (e.g., relationship building) were more supportive of knowledge transfer than masculine values (e.g., competitiveness), project management values (e.g., "a project manager manages without help" 2007, p.117) impede knowledge transfer. These suggestions were made after a longitudinal case study in which five project managers were studied in a project-based organization. In another recent study, Neuhauser (2007) suggested that not all female project managers exert transformational leadership behaviors. These behaviors have been associated with problem analysis and communication skills (Burke and Collins, 2001), which in turn can motivate and support the transfer of knowledge (Newell, 2004; Von Krogh, 2003). It is worth to mention that Rosener (1990) proposed that female uses more transactional leadership behaviors than male, which supports the Eskerod and Skriven's (2007) suggestion of differences in knowledge transfer performance based on project manager's gender.

Therefore, we set our research to (a) explore Eskerod and Skriven's (2007) suggestions about the difference in knowledge transfer performance according to project managers' gender; (b) extent their suggestions to members of the project teams, (c) extent their suggestions about roles and gender (e.g., female project managers) by incorporating project

characteristics that may encourage knowledge transfer (e.g., criticality of deliverables), and (d) extent their suggestions by incorporating a specific type of knowledge needed in projects that may encourage knowledge transfer. Next, we state the exploratory hypotheses of our investigation.

Hypotheses

Hypothesis 1: There are gender differences in the performance of knowledge transfer across projects.

Hypothesis 2: There are role differences in projects in the performance of knowledge transfer across projects.

Hypothesis 3: There are differences in the performance of knowledge transfer across projects when gender and role in projects are combined.

Hypothesis 4: There are gender differences in the use of external knowledge to solve problems in a project when the project deliverables are critical for other projects

Hypothesis 5: There are role differences in the use of external knowledge to solve problems in a project when the project deliverables are critical for other projects

Methodology

The main objective of our research is to increase understanding about the function that gender and role differences of project key actors have in transferring knowledge across projects in the project-environment. Our research approach consisted of five phases: Initial validation of the research model; Design and test of the questionnaire; Identify the research sample; Administer questionnaire; Analysis of data; and Conclusions.

The data collected in our investigation relates to the use of knowledge acquired (i.e., transferred) from other project to solve problems in critical projects performed in project-based organizations. These organizations were selected after assessing if they generate most of their services and/or products through projects. The size of the organizations included in the data ranges from 4 employees to 500,000 employees with an average size of 222,145 employees and a standard deviation of 218,207 employees. The time in operation of the organizations ranges from 1 years to 200+ years with an average of 65 years and a standard deviation of 47.8 years. The industries in which the selected organizations mainly operate include, manufacturing (n=23), information technology (n=9), construction (n=4), engineering consulting (n=17), service (n=2), aerospace (n=5), national defense (n=10), and one organization representing a single sector.

Our unit of analysis is a completed project that transferred knowledge concurrently or sequentially to and from other projects within the same project-based organization. The selection criterion was that the respondent had to be part of a project that was completed in a project-based organization. Project managers and members of project teams (i.e., key project actors or stakeholders) were the participants of the questionnaire. In the context of knowledge transfer in projects, Brookes et al. (2006) define a project actor as "an individual participating in activities that enable the project to achieve its goals" (Brookes, et al., 2006, p.477). Project actors are the basic unit that builds the relationships that will enable the transfer of knowledge across projects through a project network (Brookes, et al., 2006).

We sent an electronic link that provided access to an on-line questionnaire to 159 individuals from 57 organizations. We sent this link to the potential participants using e-mail and paper communication. We used Surveymonkey.com online survey capabilities to administer the questionnaire and organize the data. From the 159 individuals that received the link to the online questionnaire, 114 opened it and 71 completed it. We achieved a rate of response of 62% considering the 71 completed questionnaires. This rate of return is close to the 70% rate of return recommended by Girden (2000) to pose no threat of bias to the application of the questionnaire. The completed surveys contain 42 from members of project teams and 29 from project managers. The youngest respondent is 22 years old and the oldest is 60 years old, with an age average of 37 years and a standard deviation of 9.1 years. The highest time working in projects reported was 25 years and the lowest less than one year with an average of project experience of 10.6 years and a standard deviation of 7.9 years. The longest time working for the organization was reported to be 25 years, the lowest less than one year with a tenure average of 9.9 years and a standard deviation of 7.9 years. The completed surveys include 18 (25.4%) from female respondents and 53 (74.6%) from male respondents.

We asked four questions in our questionnaire to collect the data needed to study our hypotheses. To measure the performance of knowledge transfer, we asked participants to communicate the degree to which they have used knowledge from other projects to solve problems in their last project. To measure the criticality of the project, we asked participants to communicate the degree to which their last project generated deliverables that were critical for other projects. We also asked our participants to identify their gender and role in their last project.

In our statistical evaluation, we first conducted descriptive statistical analysis and

performed a cross tabulation of the data to segregate it by role and gender. We performed Friedman's tests to evaluate Hypotheses 1, 2, & 3. Friedman's tests were used due to the small sample size and ordinal scale of our variables. We then performed a two-tailed (i.e., symmetrical) correlation analysis to test Hypotheses 4 & 5. We used Spearman rank-order correlation because the scale of our variables was measured using an ordinal scale.

Results

Exhibit 1 represents the outputs of our descriptive statistical analysis. These results reveal that the level of use of knowledge from other projects to resolve problems in critical projects was higher in Male project actors (Ave.=3.75; STD=0.9) than in Female (Ave.=3.56; STD=1.15) with a difference of 5% (0.20) that was found to be not significant in the Friedman's test we performed. Therefore we reject Hypothesis 1.

With respect to the role of project actors, the results of our descriptive statistical analysis demonstrate that the level of use of knowledge from other projects to resolve problems in critical projects was higher in Project Managers (Ave.=3.76; STD=0.95) than in Members of the Project Team (Ave.=3.67; STD=0.98) with a difference of 2% (0.09) that was found to be not significant in the Friedman's test we performed. Consequently, we reject Hypothesis 2.

Exhibit 1. Results of the Descriptive Statistical Analysis of the level of use of knowledge from other projects to resolve problems in critical projects

Description	N	Ave	STD	Diff.	% of Diff.
Male	53	3.75	0.9	0.20	5%
Female	18	3.56	1.15		
Project Manager (PM)	29	3.76	0.95	0.09	2%
Member of the Project Team (MPT)	42	3.67	0.98		
Male PM	22	3.73	0.94	0.13	3%
Female PM	7	3.86	1.07		
Male MPT	31	3.77	0.88	0.41	11%
Female MPT	11	3.36	1.21		

Regarding the combination of gender and role of project actors, the results of our descriptive statistical analysis show that the level of use of knowledge from other projects to resolve problems in critical projects was higher in Female Project Managers (Ave.=3.86; STD=1.07) than in Male Project Managers (Ave.=3.73; STD=0.94) with a difference of 3% (0.13) that was found to be not significant in the Friedman test. With respect to Member of the Project Team, the results of our descriptive statistical analysis reveal that the level of use of knowledge from other projects to resolve problems in critical projects was higher in Male Members of the Project Team (Ave.=3.77; STD=0.88) than in Female Members of the Project Team (Ave.=3.36; STD=1.21) with a difference of 11% (0.41) that was found to be not significant in the Friedman's test we performed. Therefore, we reject Hypothesis 3.

Exhibit 2 represents the results of a cross-tabulation analysis using Spearman's rank-order correlations. With respect to Hypothesis 4, the results of our cross-tabulation analysis indicate that there exist a significant ($p<0.05$) positive correlation ($r=0.391$) between project team members and the use of external knowledge to solve problems in projects that generate deliverables that are critical for other projects. Regarding project managers, the results show that there is not a significant correlation ($p>0.05$) between being project manager and the use of external knowledge to solve problems in projects that generate deliverables that are critical for other projects. Therefore, we accept Hypothesis 4.

Exhibit 2. Results of Cross Tabulation Analysis Using Spearman Correlation

Individual Characteristic	N	Spearman rho	Asymp. Std. Error [a]	App. T [b]	App. Sig. [c]
Project Manager	29	.043	.198	.224	.825
Project Team Member	42	.391	.156	2.691	.010*
Male	53	.123	.154	.885	.380
Female	18	.584	.164	2.875	.011*

Notes: [a] Not assuming the null hypothesis. [b] Using the asymptotic standard error assuming the null hypothesis. [c] Based on normal approximation. * $p < 0.05$

Regarding Hypothesis 5, the results of our cross-tabulation analysis indicate that there exist a significant ($p<0.05$) positive correlation ($r=0.584$) between female and the use of external knowledge to solve problems in projects that generate deliverables that are critical for other projects. With respect to male, the results represent that there is not a significant correlation ($p>0.05$) between being male and the use of external knowledge to solve problems in projects that generate deliverables that are critical for other projects. Consequently, we accept Hypothesis 5.

Discussion

Our results explored Eskerod and Skriven's (2007) suggestions about the difference in knowledge transfer performance according to the gender and role of project managers. We also explored and extended these assumptions by incorporating project and knowledge characteristics that may encourage knowledge transfer.

Main Findings

The findings of this exploratory study reveal interesting knowledge transfer across project performance of key project actors when considering gender, role, and the combination of gender and role. Specifically, there are marginal and not statistical significant differences between the averages of the level of use of knowledge from other projects to resolve problems in critical projects (Hypotheses 1, 2, 3). Therefore, we did not find evidence to reject the Eskerod and Skriven's (2007) suggestion that Feminine or Masculine values in Project Managers would describe their performance in transferring knowledge across projects. Nevertheless, we performed further statistical analysis to evaluate these relationships in a setting that describes to a larger extent the knowledge transfer process in the project environment.

The results of our cross tabulation and correlation analyses reveal that there exist gender differences in the use of external knowledge to solve problems in a project when the project deliverables are critical for other projects (Hypothesis 4). Female in our sample demonstrated a positive and significant association between the level of use of external knowledge in solving project problems and the level of importance of the deliverables of their project to other projects. In Male we did not find any statistical significant association. Therefore, as the importance of the project increases, female seem to increase their use of other projects' knowledge to solve problems and vice versa.

Consequently, the type of knowledge and the project characteristics seems to influence the transfer of knowledge from other projects in female but not in male. This supports Eskerod and Skriven's (2007) suggestion based on Hosfstede (1980) feminine and masculine values of knowledge transfer performance in the project environment.

Our results also show that there exist role differences in the use of external knowledge to solve problems in a project when the project deliverables are critical for other projects (Hypothesis 5). Consequently, the type of knowledge and the project characteristics appear to support the transfer of knowledge in members of the project team but not in project managers. Similarly to the results of Hypothesis 4, this results support Eskerod and Skriven's (2007) suggestion that "a project manager manages without help" 2007, p.117.

Implications

From the project management perspective, we suggest that it seems to be beneficial to have female in the team of projects that have a high degree of uncertainty (i.e., crisis-prone projects) and that generate deliverables that are critical for the project-based organization. Having more female appears to increase the knowledge capability of a trouble project, which in turn may result in not re-inventing solutions to similar problems that were addressed by other projects. We recommend that project managers should consider providing members of the team of critical projects with the capabilities needed to transfer knowledge from other projects (e.g., time, social connections, information and communication technologies).

From a high-level engineering and technology management perspective, we recommend that the values of project managers that hinder the transfer of knowledge must be addressed by senior managers of project-based organizations. The goal is to engage project managers in critical, sustained, and honest self-reflection about the use of external knowledge in the project environment. This can be achieved through different organization development means that motivate and enable the project managers to adapt their values to those most needed by projects and project-based organization.

The results of our investigation support our recommendation that engineering managers in project-based organizations might consider individual differences during their technical resource allocations for critical projects. Furthermore, engineering management practitioners could avoid the pitfalls of not recognizing (a) role and gender differences in the transfer of knowledge across projects and (b) the formal and informal social network that supports the transfer of knowledge needed for the resolution of problems in complex projects.

Limitations

The results of our study have some limitations. First, the measure of the level of use of external knowledge (i.e., knowledge transferred from other projects) adopted for use in this investigation is a self-reported measure, which raises concerns of source biases. Nevertheless, self-efficacy has been suggested as being a proxy variable of learning and individual performance (Gess-Newsome, 1999; Multon, et al., 1991). Second, the sample used in this study is relative small thus posing some threat to the internal validity and to the generalization of the statistical results. Nonetheless, our objective in this investigation was to explore the relationships between the gender and the

role of key project actors with the performance of knowledge transfer of a particular type of knowledge (i.e., critical projects) in a particular project setting (i.e., presenting issues, problems, or crises).

Future Research

We encourage future research into the influence that the role and the gender of key project actors have upon the performance of knowledge transfer of technical knowledge and continuous improvement knowledge. We also encourage the replication of our research using other research approaches and sources of data. Another recommended future research topic include the study of the extent to which the gender and tenure in the organization affects the performance of the transfer of different type of knowledge during different phases of a project lifecycle.

Conclusion

The results of our investigation provide evidence of the association of the performance of knowledge transfer across projects with individual and project factors. Specifically, the results of our analysis of gender suggest that as the importance of a project increases, the use of knowledge transferred from other projects to solve problems increases in female, but not in male. With respect to the role of project actors, our results suggest that as the importance of projects increases, the use of other project's knowledge to solve problems increases in members of project teams, but not in project managers. The results of our investigation are important for knowledge and project managers of project-based organizations because they highlight differences that can impact both, the practice of project's knowledge management and the performance of projects. Our results are also important to engineering management researchers because they fill a gap in the current knowledge transfer's literature with respect to the importance of considering individual and project factors in the enhancement, design, and operation of KMSs in project-based organizations.

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