

Impact of Knowledge Sharing on Project Success in the Sri Lankan Software Industry

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Abstract

The software development process is a team effort that requires a combination of knowledge of the team members including project managers, software engineers, quality assurance engineers, technical leads, and business analysts. A team member leaving a software company has an adverse effect on projects in terms of time, cost overruns and quality issues. These effects can also result in obstructing project success. Capturing knowledge is difficult and knowledge sharing will aid such activity. This study investigated the factors contributing to knowledge sharing, namely, co-worker congruence, organizational commitment, received task interdependence, participative decision making and the relationship between knowledge sharing and project success in the Sri Lankan software industry.

The sample comprised eight software companies ranging in size in terms of number of employees. A stratified sample of 155 respondents was used in the study and the data was collected through questionnaires and discussions with managers. The study revealed that co-worker congruence, organizational commitment, participative decision making and received task interdependence positively influences knowledge sharing. Further, it was also found knowledge sharing positively influences project success, while knowledge culture moderates the relationship between knowledge sharing and project success. The implications found were that managers and organizations should take measures to develop their understanding of knowledge itself by understanding the dynamics of knowledge creation, sharing, transformation and application.

Key words: Knowledge-sharing, Co-worker congruence, Organizational commitment, Received task interdependence, Participative decision-making, Project Success.

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Background

In the last decade, the Sri Lankan economy has witnessed significant contributions from sectors such as industrial exports and IT (Information Technology). There has been a steady growth in revenue from the software companies of Sri Lanka over the last few years with many US and European companies outsourcing their software developments to Sri Lankan organizations. Information Communication Technology (ICT) is the fifth largest export earner contributing US \$ 213 million to the national economy and has the potential to reach the US \$ one billion revenue bracket within the next five to seven years (Hiran H. Senewiratne, *Daily News*, 2009, April 30). Further, this article elaborated that "with these developments Sri Lanka is rated among the top 20 destinations for outsourcing in the global arena", quoting Chairman-ICT Advisory Committee Mano Sekaram. Within the IT sector in terms of national contribution and employment aspects the role played by the software industry is outstanding. In the current knowledge-based economy companies are increasingly adapting complex IT based systems to support their core business and management processes.

In an era of knowledge workers, the software industry also uses such essential valuable resources. Sangeeta Bharadwaj and Kul Saxena (2005) consider software development organizations as knowledge intensive firms where knowledge is embedded in human beings and largely in terms of tacit knowledge. The sharing of such tacit knowledge embedded within the employees requires more people-to-people interaction which may sometimes be impossible. Due to this impossibility of sharing knowledge, it is critical to manage knowledge related to performance and learning goals, during the progress of the projects, in order to consistently sustain and improve project performance.

Software development projects have continued throughout the last 40 years to be over budget, taking longer than expected, and sometimes, not providing the level of quality and functionality expected by users. Numerous publications such as Brooks (1975), Van Genuchten (1991) and Jones (1995) support this assertion. Knowledge represents one of the key project capabilities that enable projects and project-based organizations to cope with these challenges (Rafael E. Landaeta, 2008: 29). Such knowledge may be lost to the company when knowledge workers leave the company; it is vital to share such valuable knowledge before it leaves a company.

Research Problem

Labour turnover is a common problem that affects most industries in Sri Lanka. The software industry is no exception to this, with an employee turnover rate of 8%-16%, as revealed during the pilot study. Software itself is an intangible resource that is a collaborative effort of project teams. The critical issue relevant to labour turnover is the loss of professional knowledge to handle the software projects without delays, cost overruns and quality defects such as not meeting user requirements, fitness for purpose, functionality, flexibility and adaptability.

The software industry's employees are knowledge workers with expertise knowledge. When such employees leave the company the best practices, expertise and organizational knowledge loss affect the projects. Retaining this expert knowledge within the software industry is an issue as it contains both tacit and explicit knowledge. Tacit knowledge of the employees plays a key role in the software industry in terms of handling technology. This knowledge may be transferred if the knowledge gained could be shared effectively among the team members and can be retained within the organization.

Purpose of Study

Project success in the software environment is affected by cost overruns, time overruns and quality issues. The main contributory factor as stated by the companies in the pilot study is employee turnover and the loss of knowledge. Knowledge sharing may be one way that the loss of such expert knowledge can be contained within projects for the purpose of increasing project success. The purpose of the study, therefore, is to understand the factors contributing to knowledge sharing and to identify if there is any relationship between knowledge sharing and project success as applicable in the context of the Sri Lankan software industry.

Objectives

The objectives of the research are:

- (i) To understand the factors affecting knowledge sharing in the Sri Lankan software industry.
- (ii) To assess whether knowledge sharing has any influence on project success.
- (iii) To make recommendations to improve project success in the software industry.

Significance

Knowledge management has already demonstrated a number of benefits and has offered justification for further implementation, through case studies such as Kao Cooperation. Knowledge management is a topic that is heavily discussed within the academic sector. Within the industry, research has mostly been conducted on theoretical perspectives. Very few, if any, have empirically tested these concepts relating to knowledge sharing. This research has studied knowledge sharing empirically with due consideration to factors that act as enablers towards knowledge sharing.

Literature Review

Knowledge can be considered as information that is contextual, relevant and actionable (Soliman and Youssef, 2003; Wainwright, 2001) in terms of this research study. Knowledge management (KM) is broadly understood as any process or practice of creating, acquiring, capturing, sharing and using knowledge wherever it resides to enhance learning and performance in organizations (Quintas, Lefrere and Jones, 1997).

Knowledge management strives to cut across organizational boundaries, enhance communication and collaboration and transform local knowledge into organizational knowledge. A proper knowledge management system will facilitate knowledge sharing ensuring the flow of knowledge from the person who knows to the person who needs to know throughout the organization, while knowledge grows and evolves during this process.

Waterson, Clegg and Axtell (1999) have emphasized that software development involves a variety of issues concerning the communication and coordination of knowledge relating to the programme, methodologies to be used, domain area and the various organizational practices such as reporting relationships within the project team. Managing these processes by which knowledge is acquired, shared and integrated between these various individuals, teams and organizations is a crucial task in the process of software development. (Walz, Elam and Curtis, 1993).

Knowledge sharing is the process through which explicit or tacit knowledge is communicated to other individuals (Irma et al., 2009:54). There are several views about knowledge transfer. It prevents reinventing the wheel (Bender and Fish, 2000: 130), creates shared understanding (Nickerson, Zenger, 2004: 617), and reduces uncertainty by turning individual learning into organizational learning (Nonaka, 1994: 30). Knowledge sharing has been tied to a variety of managerial, desirable outcomes, including productivity, task completion on time, organizational learning and innovativeness (Argote, 1999; Argote and Ingram, 2000; Hansen and Nohria, 2004).

"The complex and the unpredictable nature of projects generates serious challenges for managers of projects and project based organizations" (Rafael E. Landaeta, March 2008:29). The software industry is such an industry where software development is entirely a team-based effort. "Knowledge represents one of the key project capabilities that enable projects and project based organizations to cope with these challenges" (Rafael E. Landaeta, March 2008:29).

Sangeeta Bharadwaj and Kul Saxena (2005) consider software development organizations to be considered as knowledge-intensive firms where knowledge is embedded in human beings largely in terms of tacit knowledge. Sharing such tacit knowledge requires more people-to-people interaction which may sometimes be impossible. Due to this impossibility of sharing knowledge, it is critical to manage knowledge during the progress of the projects related to performance and learning

goals, in order to consistently sustain and improve project performance. The knowledge critical areas in a software industry identified by Sangeeta Bharadwaj and Kul Saxena (2005) in their study consists of user requirement knowledge, functional domain knowledge, technical knowledge, project status knowledge and project experience knowledge. Various studies have identified the enablers of knowledge sharing which are described as below.

(i) Co-worker Congruence

Previous literature has defined congruence as fit or similarity (Angeles and Nath, 2001). It is proposed that congruence should be encouraged among people and resources in formal and informal manner within organizations in order to ensure internal effectiveness and achievement of common goals (Nadler et al, 1992). According to Van Vianen (2000), co-worker congruence denotes a matching of an individual to his or her co-workers and it also refers to the homogeneity of characteristics of people, that is, interpersonal similarity. Previous theories suggest that people are looking for their opinions and abilities and seek to maximize consistency among the elements of their belief systems (Byrne, 1971; Lott and Lott, 1965, Van Vianen, 2000).

Congruence in perceptions among co-workers is a valuable concept in the more mature stage of maintaining a good relationship (Angeles and Nath, 2001). Individuals, thus, will be more attracted to co-workers who are more closely concerned about their opinions, values and goals which, in turn, will enhance their willingness to exchange experiences, affection and knowledge with their co-workers, leading to greater knowledge sharing (Chienh-Peng Lin, 2007: 459).

(ii) Organizational Commitment

Defined as an attachment to or identification of the organization (Mathieu and Zajac, 1990) (affective), organizational commitment continues to receive attention from researchers. One of the main uses of the concept of organizational commitment is derived from its relationship with its critical organizational consequences such as job performance and turnover intentions (Chienh-Peng Lin, 2007: 459). Specifically organizational commitment has been examined to influence job performance with highly committed employees performing better than less committed ones. Therefore, based on this concept it is reasonable to state that "an individual with higher organizational commitment is more likely to react with stronger knowledge sharing given that knowledge sharing influences the facilitation of group performance" (Chienh-Peng Lin, 2007: 459).

Organizational commitment also can be seen as an emotional response to a positive appraisal of the work environment (Testa, 2001). Such an emotional response may be considered as an attachment particularly when the individual believes in the organizational values and goals. Organizational commitment not only indicates the relative strength of individual identification with an involvement in a particular

organization (Mowday et. al, 1979), but is also assumed to influence almost all behavior that influences and benefits an organization including knowledge sharing, given that knowledge sharing is a way of facilitating the pursuit of organizational goals.

The identification of an organization implies supporting its goals which are achievable with knowledge sharing. Thus, employees who feel attached to and identify with their organization's work are assumed to collaborate better with co-workers by sharing knowledge comprising information and experience. "Consequently, employees with higher organizational commitment expend greater effort on group work and thus have stronger knowledge sharing " (Chienh-Peng Lin, 2007: 459).

(iii) Received Task Interdependence

Interdependence among team members is a phenomenon with the motivational potential (Van der Vegt et al., 1998). Task interdependence is vital for knowledge sharing because task interdependence strongly relates to variables of cooperation (Wageman, 1995). More specifically, it was found that changes in received task interdependence could lead to corresponding changes in other task interdependence (Kiggundu, 1981).

Team members who require co-workers to offer information and supplies to complete their tasks, can be considered as receiving task interdependence. Received task interdependence is regarded as the interconnections between tasks so that performance of one definite piece of work counts on the completion of other definite pieces of work (Van de Vegt et al, 1998). Accordingly, it can be defined, "at the individual level as the extent to which a member in a particular job is affected by the work flow from one or more other jobs" (Van de Vegt et al, 1998). Received task interdependence is what is applicable in the context of software environment project teams where the project managers will allocate integrative responsibility to each member of the project team.

From the perspective of social psychology according to literature, individuals working under circumstances that received task interdependence are more open minded in executing, sharing, helping and more concerned about each other's task performance, leading to stronger intentions of knowledge sharing (Wageman, 1995:30).

(iv) Participative Decision Making

Participative decision making is regarded as the involvement of employees in the decisions that are the responsibility or authority of the supervisor. Participative decision making produces intrinsic benefits for employees (Kearney, Hays, 1994) and increases the likelihood of constructing and maintaining mutual benefits in a group leading to stronger knowledge sharing with co-workers (Chienh-Peng Lin, 2007: 459).

Participative decision making partially reflects a working climate in cohesion. If individuals perceive their working climate to be high in cohesion during decision making then they may feel comfortable to exchange experiences and knowledge with co-workers, leading to strong knowledge sharing in a group (Chienh-Peng Lin, 2007: 459).

“Organization culture reflects the norms and beliefs that guide the behavior of the organization’s members. It is an important enabler for the organization’s members” (Dyer G. and McDonough B., May 2001: 32). A supporting organization culture that helps to motivate employees to understand the benefits of knowledge management and also find the time for knowledge management is important for the knowledge sharing activities of an organization (Dyer G. and McDonough B., May 2001: 32). The attributes identified as enabling/supportive organization culture could also be found in the definition of knowledge culture. Therefore, for the purpose of this research. knowledge culture could be defined as “an organizational culture that understands and values knowledge management” (Richard Baskerville and Alina Dulipovici, 2006:91)

According to Kaveh Mohammadi, Amir Khanlari and Babak Sohrabi (2009) in their article titled “Organizational Readiness Assessment of Knowledge Management”, they describe organizational culture as “the culture of knowledge”. This culture of knowledge according to the authors consists of four attributes which are trust, an open leadership climate, learning from failure and a culture of altruism, which are vital for the knowledge management activities fostered by organizations.

Projects are often implemented as a means of achieving the organization’s strategic plans. A project is a temporary endeavor undertaken to create a unique product or service (Guide to Project Management Body of Knowledge, 2000: 4). Team effort is what is accompanied in the software project environment which is affected by the team members leaving the organization. Software development projects have continued throughout the last 40 years to be over budget, take longer than expected and sometimes do not provide the level of quality and functionality expected by users. Numerous publications such as Brooks (1975), Van Genuchten (1991) and Jones (1995) support this assertion. Knowledge represents one of the key project capabilities that enable projects and project based organizations to cope with these challenges (Rafael E. Landaeta, 2008: 29).

Theoretical Framework

Previous studies indicate the following:

- (a) Individuals will be more attracted to co-workers who are more closely concerned about their opinions, values, goals which, in turn, will enhance their willingness to exchange experiences, affection and knowledge with their co-workers, leading to greater knowledge sharing (Chienh-Peng Lin, 2007: 459).

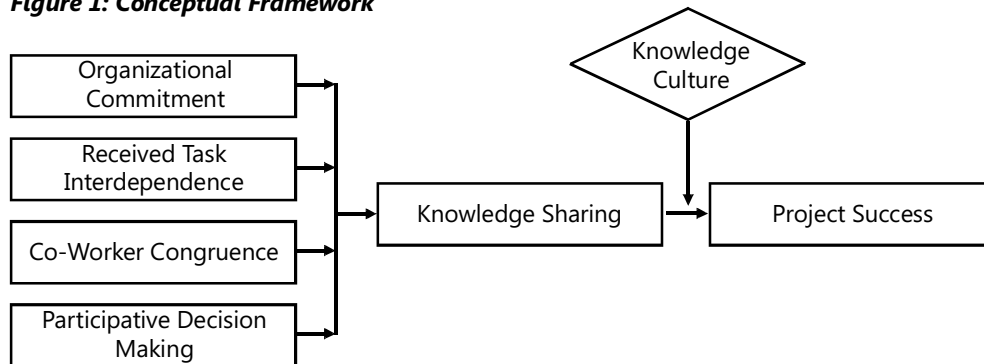
- (b) Individuals with higher organizational commitment are more likely to react with stronger knowledge sharing given that knowledge sharing influences the facilitation of group performance. Employees with higher organizational commitment expend greater effort on group work and, thus, have stronger knowledge sharing (Chienh-Peng Lin, 2007: 459).
- (c) Participative decision making partially reflects a working climate of cohesion. If individuals perceive their working climate to be high in cohesion during decision making then they may feel comfortable to exchange experiences and knowledge with co-workers, leading to strong knowledge sharing in a group (Chienh-Peng Lin, 2007: 459).
- (d) Individuals working under circumstances that received task interdependence are more open minded in executing, sharing and helping and more concerned about each other's task performance leading to stronger intentions of knowledge sharing (Wageman,1995:30).
- (e) A complementary factor that enables optimal information flow in global business processes such as knowledge management is a supportive and harmonized culture (knowledge culture) shared by all organizational constitutes (Pierre A. Balthazard and Robert A. Cooke, 2004).
"Organization culture reflects the norms and beliefs that guide the behavior of the organization's members. It is an important enabler for the organization's members" (Dyer G., and McDonough B., 2001: 32). A supporting organization culture that helps to motivate employees to understand the benefits of knowledge management and also find the time for knowledge management is important for the knowledge sharing activities of an organization (Dyer G., and McDonough B, 2001: 32).
- (f) Such knowledge is not available to the wider organization, and managers may not be aware of its existence or its importance until employees leave the organization" (Stephen Little, Paul Quintas and Tim Ray, 2002:10).
- (g) Knowledge-Management-online.com states, "Knowledge is usually difficult to access – it leaves when the knowledge professional resigns.." (Knowledge-Management-online.com, Why KM- the importance of knowledge management, accessed on June 30, 2009, < http://www.exinfm.com/board/importance_of_knowledge_management.htm>).
- (h) Sangeta Shah Bharadwaj and Kul Bhushan C. Saxena (2005) in their study of 'Knowledge Management in the Global Software Teams', state that different groups of clients, programmers, designers, testers and project managers of software teams are grouped together in the form of project teams in the software industry. Further, this article elaborates that software teams are struggling to manage the nine knowledge areas: cost, time, scope, risk, communication, team members, procurement, quality and integration related to the project management body of knowledge.

- (i) Project performance can be improved if knowledge areas related to learning and goals are managed well (Sangeta Shah Bharadwaj and Kul Bhushan C Saxena, 2005).
- (j) Software development involves a variety of issues concerning the communication and coordination of knowledge relating to programmes, the methodologies to be used, the domain area and the various organizational practices such as reporting relationship within the project team (Waterson, Clegg and Axtell, 1997).
- (k) Managing these processes by which knowledge is acquired, shared and integrated between these various individuals, teams and organizations is a crucial task in the process of software development (Walz, Elam and Curtis, 1993).

Based on the above, the following conceptual model was derived.

Conceptual Framework

Figure 1: Conceptual Framework



Hypotheses

- H1** Co-worker congruence positively influences knowledge sharing.
- H2** Organizational commitment positively influences knowledge sharing.
- H3** Received task interdependence positively influences knowledge sharing.
- H4** Participative decision making positively influences knowledge sharing.
- H5** Knowledge culture moderates the relationship between knowledge sharing and project success.
- H6** Knowledge sharing positively influences project success.

Operationalization of Key Concepts

Operational definitions of the concepts considered within the research are discussed below.

(i) Co- Worker Congruence

For the purpose of this research, co-worker congruence is defined as done by Van Vianen (2000): "co-worker congruence denotes a matching of an individual to his or her co-workers and it also refers to the homogeneity of characteristics of people, that is, interpersonal similarity".

(ii) Organizational Commitment

Organizational commitment indicates the relative strength of individual identification and involvement in a particular organization (Mowday et al., 1979). It is assumed to influence almost all behavior that influences and benefits an organization including knowledge sharing, given that knowledge sharing is a way of facilitation of the pursuit of organizational goals.

(iii) Received Task Interdependence

Received task interdependence is regarded as the interconnections between tasks such that performance of one definite piece of work counts on the completion of other definite pieces of work (Van de Vegt et al., 1998). Accordingly, it can be defined at the individual level as the extent to which a member in a particular job is affected by the work flow from one or more other jobs (Van de Vegt et al., 1998).

(iv) Participative Decision Making

Participative decision making is regarded as the involvement of employees in the decisions that are the responsibility or authority of the supervisor. (Chienh-Peng Lin, 2007: 459).

(v) Knowledge Sharing

Individuals sharing organizationally relevant experiences and information with one another (Chienh-Peng Lin, 2007: 457) is the aspect of knowledge sharing considered in this research.

(vi) Knowledge Culture

According to Richard Baskerville and Alina Dulipovici (2006:91) knowledge culture characterizes an organizational culture that understands and values knowledge

management. This knowledge culture, according to Kaveh Mohammadi, Amir Khanlari, Babak Sohrabi (2009:37), consists of four attributes: trust, an open leadership climate, learning from failure and a culture of altruism which are vital for the knowledge management activities fostered by organizations.

(vii) Project Success

The success of software projects are measured based on time, money, functionality, quality aspect and specific project aspects (Scott W. Ambler, 2008).

Sample and Methodology

The stratified sampling technique was used in this research. The population of the organization was first divided into meaningful segments based on the role that they play within project teams (Project Manager, Software Engineer, Senior Software Engineer and Tech Lead). Thereafter, subjects were drawn in proportion to their original numbers in the population. Any roles not directly influencing the teams were omitted from the study (Vice President, Department Managers). A sample size of 155 employees in various team roles has been selected for this research. The companies in the sample range from small-scale to large-scale companies. The data was obtained from eight software companies located within the Colombo district. Stratified sampling technique was used because software development is a team-based approach that accommodates employees contributing towards this effort through various roles.

A combination of qualitative and quantitative techniques was used for the research. Questionnaires were used as the primary mechanism of data gathering. Data received through questionnaires was validated through management discussions. The concept of knowledge sharing was tested using 11 Likert scale statements, two of them based on Bock G.W., Kim Y.G. (2002) and nine other statements were in accordance with the European Guide to Good Practice in Knowledge Management (2004).

The concept of Co-Worker Congruence was tested using 7 Likert scale statements based on Netemeyer et al., (2000), Van Vianen (2000), Chieh-Peng Lin (2007) and Todd Mooradian et.al,(2006). Organizational commitment was measured based on 12 Likert scale statements based on Allen, Meryer (1984) and Mowday R.T et al, (1979). Received task interdependence was measured using 2 Likert scale statements based on Van der Vegt et al., (1998). Participative decision making was tested based on 8 Likert scale statements based on Siegel A.L, Ruh R.A., (1973) and Kaveh Mohammadi et al., (2009), while the concept of knowledge culture was tested accommodating 21 Likert scale statements based on Kaveh Mohammadi et al., (2009). The project success questionnaire contained 8 rated questions based on a point scale of 1-5 adapted from James Norrie, Derek H. T. Walker (2004). Project success was validated using management discussions.

Data Analysis and Findings

The sample contained 70% (108) male employees while 30% (47) were females. The average age category was 20-30 years with 68% (106) of the sample within this age range, while 30% (46) was within the age range of 31-40 and 1.2% (2) in the age range 41-50, and the rest 0.8% (1) was in the age category of 51-60. The sample was distributed among the job categories of business stakeholder, data professional, developer/ modeler, operations/ support, IT manager, project manager, quality assurance/ test and others consisting of business analyst and user interface engineer roles. The sample consisted of 86% graduate level employees, while the remaining 14% was either GCE Ordinary Level educated or Advanced Level educated employees.

(i) Relationship between co-worker congruence and knowledge sharing

The co-worker congruence mean was at 3.6. The standard deviation of 0.42 indicates that the dispersion of the values was less than 1. The low standard deviation also confirms stable results throughout the sample. The values are 10.96% high. This indicates the majority of 89% values are moderate level values.

Table1: Relationship between Co-Worker Congruence and Knowledge Sharing

Knowledge Sharing	Mean N= 155	SD	Correlation	High %	Low %
Co-Worker Congruence	3.6	0.42	.581**	10.96%	0%
**. Correlation is significant at the 0.01 level (2-tailed).					

Source: Survey data

The relationship between co-worker congruence and knowledge sharing has a significant positive value of 0.581. The correlation is also significant at the 0.01 level (2-tailed). Therefore, the hypothesis that co-worker congruence positively influences knowledge sharing is confirmed. A clear connection between co-worker congruence and knowledge sharing was also found in discussions with managers.

At a discussion with one senior manager, it was said “you can clearly see the difference of attitude through the educational background, culture which in turn leads a person to share or not to share the information and experiences gained. Personality in terms of introversion and extroversion also matters with information/ experience sharing.” (Ms. Nenuka Sandanayake, Company A; December 9, 2009). The same idea was confirmed by other managers during the discussions as “People who are introvert will be introvert within project and vice versa.” (Mr. Gayath Rathnayake, Company D; December 10, 2009).

The management discussions of all other companies also supported the fact that co-worker congruence has a direct positive influence on knowledge-sharing. Therefore, the hypothesis, co-worker congruence positively influences knowledge sharing, is also confirmed in discussions with management.

The analysis confirmed that matching values and different expertise creates the best performing teams as compatibility was created between the team members while they had different expertise and knowledge that made it interesting to share. Many companies viewed co-worker congruence as attitudinal differences between the employees in terms of sharing. However, personality in terms of introversion and extroversion was also emphasized in relation to information/ experience sharing. According to the findings, personalities who were introvert were found to be introverted within project teams and vice versa.

(ii) Relationship between organizational commitment and knowledge-sharing

The relationship between organizational commitment and knowledge-sharing is depicted below.

Table 2: Relationship between Organizational Commitment and Knowledge-Sharing

Knowledge Sharing	Mean N= 155	SD	Correlation	High %	Low %
Organizational Commitment	3.5	0.65	.525**	19.35%	1.29%
**. Correlation is significant at the 0.01 level (2-tailed).					

Source: Survey data

The organizational commitment mean was at 3.5. The standard deviation of 0.65 indicates that the dispersion of the values is less than 1. The low standard deviation also confirms stable results throughout the sample. The values are 19.35% high and 1.29 % low. This indicates the majority of 79% values are moderate.

A positive co-relational value of 0.525 shows a significant positive co-relation between organizational commitment and knowledge-sharing. Therefore, the hypothesis that organizational commitment positively influences knowledge-sharing is confirmed. Interview sessions also revealed and confirmed this as indicated below.

One manager expressed attachment at two levels as “more than attachment to the company; team attachment is more prominent. ” (Mr. Gayath Rathnayake, Company D; December 10, 2009) Further, “Knowledge has a value in the company and that attachment towards the company will make more knowledge to be shared”. (Mr. Lasika Fonseka, Company E; December 13, 2009).

Therefore, it is further clear that the hypothesis that organizational commitment positively influences knowledge-sharing is also confirmed in discussions with management. A moderate level of organizational commitment was revealed across the software companies. Study findings confirmed a significant positive co-relation between organizational commitment and knowledge-sharing with aid of quantitative and qualitative methodologies. Study findings also confirmed that individuals with higher organizational commitment were more likely to react with stronger knowledge-sharing given that knowledge-sharing influences the facilitation of group performance. Employees with higher organizational commitment were more likely to expend greater effort on group work thus exhibiting stronger knowledge-sharing.

Many companies have used opportunities and challenges as creators of organizational commitment, while some companies were strongly supportive of using monetary rewards as the mechanism of commitment. Yet, most successful companies in terms of less employee turnover rates and higher commitment values have used a combination of the above, along with a more humane aspect of concern for people. These companies have gone to the extent of providing day care facilities for employees' children within the premises and have also utilized flexible scheduling in terms of project plans.

(iii) Relationship between received task interdependence and knowledge-sharing

The Table below indicates the relationship between received task interdependence and knowledge-sharing.

Table 3: Relationship between Received Task Interdependence and Knowledge Sharing

Knowledge Sharing	Mean N= 155	SD	Correlation	High %	Low %
Received Task Interdependence	3.5	0.82	.217**	9.03%	1.94%
**. Correlation is significant at the 0.01 level (2-tailed).					

Source: Survey data

Received task interdependence contains a mean value of 3.5. The standard deviation is 0.82. The low standard deviation also confirms stable results throughout the sample. The values are 9.03% high and 1.94% low indicating that the majority 89% of the values are contained within the moderate level.

A positive value of 0.217 shows a positive correlation between received task interdependence and knowledge-sharing with a 99% significance level. The correlation is significant at the 0.01 level (2-tailed). Therefore, the hypothesis that received task interdependence positively influences knowledge-sharing is confirmed.

A manager expressed received task interdependence as “In fact this is what generally happens. Modules are broken down into software layers. Skills of the employees are also limited as some people may be good at front end, others back end.” (Mr. Shan Gunawardena, Company G; December 16, 2009). “Passing the information is essential to this company” (Mr. Chinthaka Palliyaguru, Company H; December 14, 2009).

In all software companies task interdependence was considered the norm. Discussions with management, therefore, confirmed the hypothesis that received task interdependence positively influences knowledge-sharing. Study findings also confirmed that individuals working under circumstances of received task interdependence are more open-minded in executing, sharing and helping and more concerned with each other’s task performance leading to stronger intentions of knowledge-sharing. A moderate level of received task interdependence was found across the software industry.

(iv) Relationship between participative decision making and knowledge-sharing

Participative decision making has a mean value of 3.5 and a standard deviation of 0.46, which indicates that most of the values are scattered around the mean. The low standard deviation also confirms stable results throughout the sample while values contained within the moderate level are 93%, high values are 5.81% and low values are 0.64%.

Table 4 below indicates the relationship between the participative decision making and knowledge sharing. A positive value of 0.631 shows a strong positive correlation between participative decision making and knowledge-sharing. Also the correlation is significant at the 0.01 level (2-tailed).

Table 4: Relationship between Participative Decision Making and Knowledge-Sharing

Knowledge Sharing	Mean N= 155	SD	Correlation	High %	Low %
Participative Decision Making	3.5	0.46	.631**	5.81%	0.64%

** . Correlation is significant at the 0.01 level (2-tailed).

Source: Survey data

Many managers conformed to participative decision making by indicating “Each team will coordinate with the project manager and share the responsibility. Each project manager will be responsible for sharing information and for status handling ”(Mr. Mario Gooneratne, Company F; December 14, 2009), and “Team oriented culture is fostered within this company ”(Mr. Chinthaka Palliyaguru, Company H; December 14, 2009).

Further, management interviews indicated that “When decisions are taken the reason as to why that decision was taken will be communicated to the relevant team” (Mr. Vajira De Silva Koralage, Company C; December 9, 2009). Some companies also adhere to extensive participative decision making as indicated by the following: “Brainstorming sessions are conducted to solve problems within this organization and the best and most cost effective idea is implemented” (Mr. Chinthaka Palliyaguru, Company H; December 14, 2009).

Therefore, it is confirmed that participative decision making is considered vital within the software industry and is considered to have an effect on knowledge-sharing. This establishes and confirms the hypothesis that participative decision making positively influences knowledge-sharing. Many software companies in the sample utilized meetings as the prominent method of participative decision making. A few companies also went to the extent of accompanying brainstorming sessions to make decisions. Transparency of decisions, communication of decisions and why a particular decision was selected against another, was considered to be important by the companies which obtained high values for participative decision making.

Participative decision making prominently was seen as a creator of ownership for the software teams as the decisions are collective and not individual-based. Companies which had high participative decision making values indicated that the employees were invited to share in the decision-making process by participating in activities such as setting goals, determining work schedules, and making suggestions. Other forms of participative management adapted by these companies included increasing the responsibility of employees (job enrichment), forming self-managed teams, quality circles, or quality-of-work-life committees and soliciting survey feedback. Participative management in these companies, however, involved more than allowing employees to take part in making decisions. It also involved management treating the ideas and suggestions of employees with consideration and respect. This process according to these companies aided knowledge workers to express opinions. This is considered vital by knowledge workers.

(v) Relationship between knowledge-sharing and project success

The knowledge-sharing mean was at 3.9. The standard deviation of 0.42 indicates that the dispersion of the values is less than 1. The low standard deviation also confirms stable results throughout the sample. Values contained within the moderate level are 71%, while high is 28.38% and low is 0.64% as indicated in Table 5 below.

Table 5: Relationship between Knowledge-Sharing and Project Success

Knowledge Sharing	Mean N= 155	SD	Correlation	High %	Low %
Knowledge - Sharing	3.9	0.42	.325**	28.38%	0%
** . Correlation is significant at the 0.01 level (2-tailed).					

Source: Survey data

The results shown in Table 5 indicate a significant positive correlation of 0.325 between knowledge-sharing and project success. The level of significance between the two concepts is 2-tailed. Therefore, the hypothesis that knowledge-sharing positively influences project success is confirmed. Discussions with management also confirmed the relationship through the following statements.

“For project success, project level knowledge is required.” (Mr. Dinesh Sathischandra, Company C; December 9, 2009). Different companies have implemented extensive measures to retain and share knowledge as indicated by “Each team has a wiki where the extensive intra-team communication is conducted. Design, architecture, product documentation is available in the wiki where the inter-team members can also access and make comments.” (Mr. Gayath Rathnayake, Company D; December 10, 2009). Further, management has also taken steps to implement a knowledge-based system as explained by “a common knowledge-based system is in place in our company to elevate information within groups. For example, if we take an Oracle issue it is handled by the Oracle group. The group being unable to solve the issue will gain direct contact with the vendors. These vendor contacts are also maintained by the company. If by contacting the vendors the issue is solved the knowledge base will be updated to reflect the new knowledge added.” (Mr. Mario Gooneratne, Company F; December 14, 2009).

The above discussions with management confirm the hypothesis that knowledge-sharing positively influences project success and also acknowledges the mechanisms and importance provided for knowledge-sharing by the companies to ensure project success.

Companies which had high value for knowledge-sharing had implemented technologies (Wiki's, forums, share portal, knowledge repositories) and also had knowledge management initiatives such as knowledge management teams. One company also specified the benefits of having a knowledge-sharing initiative as it tremendously reduces rework and ultimately will aid company profitability. Some companies with moderate values in knowledge-sharing were initiating mechanisms to improve knowledge-sharing by having knowledge-transfer sessions and also were in the process of incorporating technology to achieve the aim. They were in the process of storing domain specific knowledge, white papers and code snippets.

Project success was measured using time, cost and quality aspects by most companies, while there were individual matrices which were also used in some companies. Most companies across the sample showed a moderate level of project success, while the high level of project success was achieved by companies which also had a high level of knowledge-sharing values. A company which had high project success indicated that the company had extensively used collaboration tools such as MS project server, Sun Micro System's Java Messaging Server, discussion portals, blogging, emails, VOIP (Voice Over Internet Protocol) to ensure project success through knowledge-sharing. A company which had a moderate level project success indicated that they handle mostly product development which

was considered to be embedded with knowledge. One company which had a high rate of project success indicated that for project success, project level knowledge is required, while for organizational success, organizational knowledge was required.

(vi) Knowledge culture moderates the relationship between knowledge sharing and project.

The relationship between knowledge sharing and knowledge culture is significant with a co-relational value of 0.751, which indicates a strong positive correlation which has a 2-tailed significance level. The relationship between project success and knowledge culture is a positive relationship with a correlational value of 0.336 and a significance value within the 2-tailed range. When considering the moderator effect of knowledge culture on the relationship between knowledge-sharing and project success it is evident that it is a positive correlational value of 0.117 that is statistically significant.

According to the results, it is evident that knowledge-sharing and project success are positively correlated initially with an r value of 0.325 and $p < 0.05$. With the control of knowledge culture, however, the relationship has been affected significantly with the r value changing to 0.148 and $p > 0.05$. This indicates knowledge culture moderates the relationship between knowledge-sharing and

Table 6: Partial Correlation

Control Variables			Knowledge Sharing	Project Success	Knowledge Culture
-none-a	Knowledge Sharing	Correlation	1.000	.325	.751
		Significance (2-tailed)	.	.000	.000
		Df	0	153	153
	Project Success	Correlation	.325	1.000	.336
		Significance (2-tailed)	.000	.	.000
		Df	153	0	153
	Knowledge Culture	Correlation	.751	.336	1.000
		Significance (2-tailed)	.000	.000	.
		Df	153	153	0
Knowledge Culture	Knowledge Sharing	Correlation	1.000	.117	
		Significance (2-tailed)	.	.148	
		Df	0	152	
	Project Success	Correlation	.117	1.000	
		Significance (2-tailed)	.148	.	
		Df	152	0	

project success dramatically. Statistically, knowledge culture has a moderating effect on the relationship between knowledge-sharing and project success. Therefore, the hypothesis that knowledge culture moderates the relationship between knowledge-sharing and project success, is confirmed.

The culture of the software environment in terms of knowledge- sharing was considered essential by many companies as indicated by the following statements.

“Open culture is maintained from the founders itself in our company. Family matters, issues are all discussed within the company itself. It benefits not only information but also sharing of experience as well.” (Mr. Mario Gooneratne, Company F; December 14, 2009). “Transparency of issues is vital along with care for people. Work-life balance is also important with realistic scheduling and estimation to the client.” (Mr. Shan Gunawardena, Company G; December 16, 2009). Certain company cultures have been adapting specific values that foster knowledge sharing as explained in the following statement: “Culture is based on four values which are respect, integrity, leadership and pursuit of excellence. It is important that we adhere to these values at all levels to become more successful.” (Mr. Vajira De Silva Koralage, Company C; December 9, 2009).

Therefore, the hypothesis, knowledge culture moderates the relationship between knowledge-sharing and project success, is confirmed in the discussions with management. Study findings indicated that knowledge culture was built on values such as trust, open leadership climate, learning from failures and culture of altruism. These attributes were found to be important attributes in knowledge-sharing. These values have been extensively contributing towards ensuring effective knowledge-sharing. A company which had moderate knowledge culture values indicated equal opportunity to everyone and a performance-based hierarchy with transparency in decision-making was important for the organization along with open communication. A company which had high knowledge culture explained that respect, integrity, leadership and pursuit of excellence were the key guiding principles prominent within all levels of the company.

Regression Analysis

The factors affecting knowledge-sharing have been identified as co-worker congruence, received task interdependence, organizational commitment and participative decision-making. Within the hypotheses confirmation, the relationship between factors affecting knowledge-sharing and knowledge- sharing itself was found to be significant at the 0.01 level (2-tailed) and positive. In order to identify how much of contribution each factor elicits as a function of knowledge-sharing,

a regression analysis was undertaken. The result of the regression analysis is presented below.

The R-squared value of the resultant table (Table 7) below indicates that the fraction of variation in the data is 0.512. The R-squared value shows that more than 51% of the relationship is explained with the concepts.

Table 7: Regression Analysis and Coefficients

Value	Constant	Co-worker Congruence	Organizational Commitment	Task Interdependence	Participative Decision Making
Beta	1.057	.345	.053	.030	.359
R Square	.512				

a. Dependent Variable: KS

Source: Survey data

From the regression analysis between co-worker congruence, organizational commitment, received task interdependence, participative decision making factors to knowledge-sharing (using the Beta value from the above table) the following equation has been derived from the data obtained from the participatory groups: the dependent variable knowledge sharing(Y) and the independent variables X1 identifying co-worker congruence, X2 identifying organizational commitment, X3 identifying received task interdependence and X4 identifying participative decision-making. The equation arrived at is,

$$Y = 1.057 + 0.345 X1 + 0.053 X2 + 0.046 X3 + 0.359 X4$$

The regression analysis confirmed that more than 51% of knowledge-sharing was explained through the use of co-worker congruence, organizational commitment, received task interdependence and participative decision making. During the analysis, the companies which scored high values on all four aspects had high results in terms of knowledge sharing while the majority of companies which had a moderate level on all four factors had a moderate level of knowledge-sharing.

Factor Analysis

Table 8 below presents the factor analysis conducted on knowledge-sharing. The factor loadings are the correlation coefficients between the variables and factors, and are the basis for imputing a label for different factors. Loadings above 0.5 are considered high and those below 0.4 are considered low. The 11 items developed to operationalize knowledge sharing were examined using the Varimax rotation method with Kaiser Normalization. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.721, which was greater than 0.60, hence, means that factor analysis is reliable in respect of the data set and four factors emerged out of analysis.

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The variables strongly loaded with factor one (technology, organizational structure, norms) relates to ways in which the organization is structured to incorporate knowledge-sharing through technology and different methodologies. Therefore, this factor is referred to as 'organizational'. Factor two (sharing your knowledge for the benefit of others) relates to the degree of knowledge-sharing perceived by an

Table 8: Factor Analysis on Knowledge- Sharing

Item ID	Items Kaiser-Meyer-Olkin Measure of Sampling Adequacy 0.721	Component			
		Factor 1 Organizational	Factor 2 Personal	Factor 3 Culture	Factor 4 Strategy
Q42	We have the right systems, like databases, intranets, team rooms and emails to support knowledge Sharing (Communality -0.65)	<u>.74</u>	.25	-.14	-.09
Q27	We spend time to share our ideas and experiences with others, even if this is not directly relevant for our job (Communality-0.61)	<u>.71</u>	-.11	.27	.14
Q22	The management motivates staff to share knowledge by building trust, giving incentives, making available time and resources (Communality -0.54)	<u>.68</u>	.10	-.04	.26
Q37	The way we are organized (departments, meetings) doesn't introduce any barriers to knowledge sharing (Communality -0.46)	<u>.45</u>	.09	.27	.41
Q7	I share my knowledge with any co-worker if it is helpful for the organization (Communality 0.76)	.11	<u>.86</u>	.10	.03
Q46	I like to share my ideas and experiences with others (Communality 0.73)	.09	<u>.82</u>	.23	.07
Q49	By sharing my knowledge I have made a significant contribution to the organization (Communality- 0.68)	-.02	.16	<u>.80</u>	.06
Q1	I share knowledge with my co-workers in an effective way (Communality - 0.56)	-.03	.43	<u>.61</u>	.02
Q32	We know how we can optimally share our knowledge with each other (Communality - 0.57)	.51	.01	<u>.55</u>	-.13
Q13	The strategy of our organization can only be realized if knowledge is shared (Communality - 0.79)	.01	.02	.05	<u>.89</u>
Q17	In our organization "knowledge sharing is power" applies more than "possessing knowledge is power" (Communality - 0.56)	.47	.09	-.17	<u>.55</u>

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.
 Factor loadings are underlined. Source: Survey data

individual. The variables grouped under this category stress the word 'I' representing the individual's perception. Therefore, it is labeled as 'personal'. The variables strongly loaded with factor three (sharing knowledge for the benefit of the organization) relates to the degree of knowledge-sharing encouraged by the culture, environment and the value system of the company. This factor can, therefore, be labeled as 'culture'. Factor four (how much is knowledge-sharing incorporated in company strategy) relates to the degree of knowledge-sharing required by the company in their efforts to reach a common company goal. This factor is, therefore, labeled as 'strategy'.

Items Q42, Q27, Q22 and Q37 were significantly positively correlated to 'organizational' factor, while they contain a low level of correlation with other factors. Item Q42 has a factor loading of 0.743 and the communality of the variable was 0.65. Therefore, 65% of the variance in item Q42 could be explained through the four factors identified. Item Q27 has a factor loading of 0.71, while 61% of the variance can be explained through the four factors identified. Item Q22 has a factor loading of 0.68 and 54% of the variance can be explained through the four factors identified. Item Q37 is positively correlated to factor 1 (0.45) and to factor 4 (0.41), while towards other factors it is negligible. Factor loading of item Q37 was 0.45, while 46% of the variance can be explained through the four factors identified.

Item Q7 and Q46 are both significantly positively correlated to factor 2 'personal' factor with factor loadings of 0.86 and 0.82 respectively. Item Q7 can be 76% explained with the four factors, while with item Q46, 73% of the variations could be explained.

Item Q49, Q1 and Q32 are all grouped with factor 3 'Culture' with correlation values of 0.80, 0.61 and 0.55 respectively. Therefore, factor loading for Q49, Q1 and Q32 will be 0.80, 0.61 and 0.55 respectively. The four factors identified describe the variance of Q49 up to 68%, Q1 up to 56% and Q32 up to 57%.

Items Q13 and Q17 have a strong positive correlation to factor four 'Strategy' with factor loading values of 0.89 and 0.55 respectively. The factors identify the variance of Item Q13 up to 79% and Q17 up to 56%.

Knowledge-sharing during the factor analysis was found to be a combination of four essential components comprising 'organizational' which relates to structuring of the company and the norms, 'culture' which relates to the values within the company, 'personal' aspect which relates to individual personality aspects and also 'strategy' which relates to how much knowledge sharing is incorporated into company strategy in order to achieve the common company goals.

With the organizational factor the importance was found to be high on accommodation of technological aspects such as systems, intranets, team rooms for information sharing, sharing of information/experiences/ideas with others, even if it is not relevant to an individual's job. Further, the organizational factor also

included management motivation provided to staff by building trust, giving incentives, making available time and resources and physical layout of departments/offices not to introduce any barriers to knowledge sharing. Personal factor includes the individual's personal willingness to share knowledge with any co-worker if it is helpful for the organization, sharing ideas and experience with others. The culture aspect looked at knowledge-sharing in an effective/optimal manner and sharing knowledge so that it acts as a contribution to the organization. The strategy aspect looked at how important knowledge-sharing was for the accomplishment of company strategy and whether sharing knowledge was more important than possessing it.

Conclusion

The study findings were in line with previous studies conducted by Chienh-Peng Lin (2007), indicating (a) a significant positive correlation between co-worker congruence and knowledge-sharing, (b) a significant positive correlation between organizational commitment and knowledge-sharing, (c) a significant positive correlation between participative decision-making and knowledge-sharing was applicable in the context of the Sri Lankan software industry. Previous studies conducted by Wageman (1995) were reinforced by the findings indicating a significant positive correlation between received task interdependence and knowledge-sharing. These study findings supported previous studies by Shah Bharadwaj and Kul Bhushan C. Saxena (2005), indicating a significant positive correlation between knowledge-sharing and project success, which is also applicable in the context of the Sri Lankan software industry. The findings further supported previous studies by Pierre A. Balthazar and Robert A. Cooke (2004), indicating a significant positive partial co-relation between knowledge culture influencing the relationship between knowledge-sharing and project success as applicable to the Sri Lankan software industry. All of the above mentioned previous studies were also found to be applicable to the Sri Lankan software industry as well.

Managers and organizations have to develop their understanding of knowledge itself. This means understanding the dynamic process of knowing and the processes of knowledge creation, sharing, transformation and application. This requires first an acknowledgement of the challenges posed by the characteristics of the knowledge. Not least, much of the knowledge upon which organizations rely on is tacit. This tacit knowledge resides within the heads and neuron systems of employees that have not been codified or made explicit. Therefore, managerial level initiatives and encouragement are required to share this knowledge residing within the neurons of the employees.

Knowledge-sharing can impact on the people within an organization by facilitating learning from each other as well as from external sources, causing employees to become more flexible within the technology, while enhancing job satisfaction. Knowledge-sharing also contributes towards the organizational processes by (a) improving effectiveness through performing the most suitable processes and making

the best possible decisions, (b) improving efficiency by performing the processes quickly and in a low cost manner and (c) improving innovative ability by performing the processes in a creative and a novel manner that improves efficiency and effectiveness. Knowledge-sharing can also enable employees to shorten the learning curve and quickly educate less trained employees to achieve higher performance levels. It also enhances employee problem solving capacity by providing access to compiled subject, customer reference and resource files available either directly or through a system.

This study was limited to identifying the impact that knowledge-sharing has on the success of software projects. Future work in relation to knowledge-sharing and project success within the Sri Lankan software industry should consider the impact of the personal aspects such as trust and communication skills of individuals on knowledge-sharing. It was also found that the leadership of organizations also influences knowledge-sharing efforts. Future research could be conducted on this aspect as well. The adaption of the same study framework for other knowledge intensive industries also could be investigated.

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