CHAPTER 2

2 LITERATURE REVIEW

The last several decades have witnessed a steady trend toward globalization of business, and of software intensive high technology business in particular. Economic forces suggest new forms of competition and cooperation that reach across national boundaries. As a result, software development is increasingly multi-site, multicultural, globally distributed undertaking (Herbsleb and Moitra, 2001).

Research papers, journal articles, Emerald site and various books were used to search for existing literature on virtual software development projects.

The phenomenon introduced numerous challenges on many levels in software project management components. Accordingly, this chapter will present a comprehensive literature survey on the concepts of virtual software development. The review comprises of few sections, review of research undertaken in virtual teams, project success dimensions in virtual teams, virtual team decision making and determining factors of effective decision making as well as the necessary definitions of terms.

Empirical researches on same discipline on the same research base which is the impact of effective decision making on project success in virtual software development projects in Sri Lanka is quite limited. Literature was found on more similar researches which are different disciplines on the different research bases around the world.

2.1 VIRTUAL PROJECT TEAMS

In recent years, many researchers have studied aspects of organizational problems, as witnessed by the impressive number of papers published on teams distributed, dispersed, decentralized, and virtual (Cramton and Webber, 2005; Gibson and Cohen, 2003; Zolin et al., 2004).

Although these studies show some differences in what they designate as virtual project teams, they generally refer to **a group of people who must collaborate**

despite geographical and time boundaries, by using information and communication technologies at varying degrees of intensity.

The distinctions between various levels of virtuality stem from geographical distance and cultural differences. Child (2005) defines a *virtual* or *dispersed team i*s a group of geographically and temporally dispersed individuals who are assembled by means of information and communications technology (ICT) to accomplish an organizational task. The term that is used throughout this research is the one of virtual teams. Usually the definition provided for such teams on certain criteria such as team organization and structure, project operations, team processes, project and team management and communications. Hence, in most virtual teams the members are usually distributed and quite frequently various resources are geographically dispersed over different time zones. Virtual teams may involve more than one organization, meaning the different team members may belong to different companies but still work on the same project. Additionally, virtual teams need frequent and structured communication and use primarily electronic means for their interactions. A high level of trust is required for virtual teams to perform effectively and avoid any delays and conflicts, much higher than in traditional collocated teams. Most processes are flexible and agreed by the participating team with respect to the requirement of the specific project (Mayer, 1998).

2.2 VIRTUAL TEAMS IN SOFTWARE DEVELOPMENT INDUSTRY

Virtual software development (VSD) is simply defined as the software development activities distributed across multiple sites (Mockus and Herbsleb, 2001). Activities of a global scope are both dispersed and carried out at different locations and asynchronous (carried out at different times).

Introducing VSPT brings several benefits into the software development industry. Most of these benefits are achieved by exploring the main differences between the characteristics of virtual teams and collocated teams. Many organizations have access to a larger pool of computer skills, reduce software development time by running 24-hour shifts with disperse teams, and decrease labor costs by outsourcing software development to low wage countries. Apart from these catalyst benefits there are

sustaining benefits that support the move from traditional to virtual teams. Such benefits are internationalizing software, creating localization centers, building an experience and knowledge base for each team, manager smaller size sites and teams, avoiding constant distractions from headquarters (Duarte and Snyder, 1999; Grenier and Metes, 1995).

Therefore, today, most major companies develop software in a globally distributed fashion, though; VSD creates a number of challenges (Herbsleb and Grinter, 1999; Carmel, 1999). According to the survey done on 'Challenges in Virtual teams' by Solomon (2010) it has been found virtual teams more challenging than face to face teams in managing conflict (73%), making decisions (69%), and expressing opinions (64%). They also stated that delivering quality output (48%) and generating innovative ideas (47%) were more challenging in a virtual environment.

Considering that technology is now available to enable team-working on a global basis, the major challenge now appears to be how to organize and manage this approach more effectively.

Studies such as that of Maznevski and Chudoba (2000) shed some light on the conditions required for positive interaction within such teams. In their research with a United States industrial technology company and two of its European strategic partners, they found that one requirement is the fit between the form chosen for interaction (medium and duration) and the decision-making process and complexity of the communication required within the team. For example, to build commitment, team members must be highly involved in the decision-making process, an act that necessitates the exchange of complex messages. Consequently, effective interaction in this situation requires rich communication media. Less rich communication media such as e-mails and instant messaging would not be adequate in that case. Trying to discuss complex strategic issues via e-mails proved to be an inappropriate fit and was unsuccessful (Child, 2005; Maznevski and Chudoba, 2000). In addition, face- to-face meetings were found to be particularly important in the early stages of a team's life. Other challenges of working with virtual members include building relationships to increase trust and creating an identity as a team to compensate for members' isolation. Indeed, past research has identified several determining factors associated with team performance, such as trust, group cohesion, and information channels (Maznevski and

Chudoba, 2000). More recently, Martins et al. (2004) observed that each team belongs to a certain level of virtuality and needs appropriate structures. The factors that influence how virtual teams operate and perform include, among others, group size, individual competences, the technology in place, and the nature of tasks. Empirical studies conducted by Paul et al. (2004) showed that a collaborative style of conflict management improves virtual team members' satisfaction with decision making, perceived quality, and member participation, no matter how homogeneous or heterogeneous the team may be. Evaristo, Scudder, Desouza, and Sato (2004) carried out case studies on companies in the United States, Japan, and Europe to understand the impact of distributedness on project management as it relates to such various dimensions as structure (control, communication), perceived distance, complexity, level of dispersion, and types of stakeholders, to name a few. Evaristo et al. (2004) found that, depending on the type of industry, particular dimensions of distributedness were more or less prevalent. For instance, the *structure* dimension is more important in the software industry than in manufacturing.

Despite the value of these results for the successful management of virtual teams will always lead to the success of project. However, most authors call for more research, as several key aspects success criteria have not yet been defined, especially from a project management perspective (Evaristo et al., 2004). This is particularly true of the concepts related to decision-making.

2.3 PROJECT SUCCESS

Generally a project success can be viewed narrowly as achievement of intended outcomes in terms of specification, time and budget. Whilst this was widely accepted as appropriate in early writings on project management, the project context has shifted and it is now recognized that a broader set of outcome measures is now generally needed (Atkinson, 1999; Pinto and Slevin, 1988). Factors which have led to this view, in part, result from a broader strategic perspective being required by the many project stakeholders. Such influences include the growing concern to ensure maximization of the lifetime value of the project endeavor (Bonnal et al., 2002; Jaafari, 2000), the notion of the sustainable enterprise (Lidow, 1999) the growth in interest in knowledge

as the source of competitive advantage (Ruggles, 1997), the importance of motivation as a source for better project execution (Graham, 1987; Steers et al., 1996), the idea of evaluation led project or program endeavors (Gareis and Hueman, 2000; Pellegrinelli, 2002), and the general turbulence of the business environment as mentioned earlier. So projects are viewed less as isolated sequences of events aimed at a short-term goal and having limited impact and rather more as long term strategic interventions which, to be accepted, have to enhance the economic, social and environmental well being of the various project stakeholders (Lim and Mohamed, 1999; Turner, 2002; Wateridge, 1998).

Within knowledge-based enterprises projects are also being considered as an arena for learning; the uniqueness of projects makes each rich in opportunities for personal and organizational learning (Ays, 1996; Lundin and Midler, 1998). Munns and Bjeirmi (1996) use the concept project management success with traditional view with a focus on the successful accomplishment of cost, time, and quality objectives and the quality of the project processes or work. These matters are regarded as the responsibilities of project management and a successful outcome on these would be considered a project management success. Baccarini (1999) adopts a somewhat different approach and uses the descriptor, product success, to illicit the impact of a project when its execution is finished, such as; meeting the project owner's strategic organizational objectives, satisfaction of users' need, and satisfaction of stakeholders' need where they relate to the product. It also includes criteria such as knowledge creation and dissemination, which today many project owners include as factors that determine if the project is successful or not. Most of researches were identified overall project success as the broader concept, which deals with the wider and longer term impact of the project, i.e. both project management success and the project product success.

Project management success can be determined at the end of the project. Expanding the success criteria as the concept overall project success indicates will necessarily postpone the final judgment on the project. The performance on some of these success criteria will be finally decided months or years after the termination of the project.

The two different success concepts should enlighten the debate on whether a project is a success or not. A project might in one sense (project management success) be regarded as a success, but in another (product success) be regarded as a failure, and

even the vice versa situation might occur. Given this broader set of expected outcomes, it seems reasonable to presume that project management needs to respond rather differently than as in the case of the more traditional view. Project management, given the unique nature of each individual project, is an area seen as benefiting from focusing management's attention on such critical success factors.

Pinto and Slevin (1987) have, with their project implementation profile made a valuable contribution to the field of project management insofar as they have demonstrated how to use critical success factors to diagnose a project's status. They used as critical success factors: project mission (clarity of goals and general direction), top management support, project schedule/plans and decision making, client consultation, personnel (recruitment, selection, and training), technical tasks (availability of the required technology and expertise), client acceptance, monitoring and feedback, communication, and trouble shooting (ability to handle unexpected crises and deviations from plan). Later writers have added some other factors to this list. More recently, writers have overviewed critical success factors; for examples, Belassi and Tukel group the factors into four areas: factors related to the project (i.e. size, uniqueness, urgency), the project manager and the team members (i.e. skills, background), the organization (i.e. management support, structure), and the external environment (i.e. political, technological). Westerveld uses the European foundation for quality management model as his approach for categorizing the different critical success factors. A project excellence model is presented with the following critical success factors: leadership and team, policy and strategy, stakeholder management, resources, contracting, and project management. Obviously there are different opinions as to which factors are critical for project success.

2.4 SOFTWARE DEVELOPMENT PROJECT SUCCESS

In software development aspects, project success is traditionally measured using the "golden triangle", which means completing the project on time, within budget and to specification (PMI, 2004). Most project managers see their job as successfully completed when they finish the project on time, within budget and to specifications. This "operational mindset" is clearly reflected in project management literature,

which has traditionally used time, budget, and meeting end product specifications as the main indicators of project success which is shown in Figure 2-1. Hence this is called by the "get the job done" appro

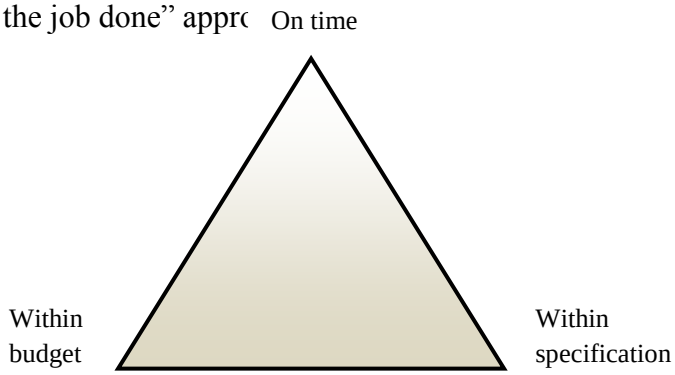

Figure 2-1: Golden triangle

However, several studies support the inclusion of customer satisfaction as the fourth dimension of success (Lipovetsky et al., 1997; Zwikael and Sadeh, 2007; Kerzner, 2006). These measures even when taken together, are incompleted and may be misleading. They may count as successful projects that met time and budget constraints, but did not meet customer needs and requirements (Atkinson, 1999).

Several studies suggested adding customer satisfaction to the assessment of project success (Lipovetskey et al., 1997; Lim and Mohamed, 1999). Baker et al. (1988) went further, to include the satisfaction of four stakeholders:

- Customer
- Developer
- Team
- End-user

The idea that project success may differ according to the assessor, facilitated the introduction of multi-dimensional frameworks for the assessment of project success. Pinto and Mantel (1990) identified three aspects of project performance as benchmarks for project success: the implementation, the perceived value of the project, and client satisfaction. Freeman and Beale (1992) identified seven criteria for project success: technical performance, efficiency of execution, managerial and organizational implications (including customer satisfaction), personal growth, manufacturers' ability and business performance.

More recently, Shenhar et al. (2001) suggested a four dimensional framework for assessing project success, including: Efficiency (did the project meet schedule and budget goals); Impact on customers (benefit to customers in terms of end products) and Business success (benefit gained by the developing organization as a result of the project. This framework is more suitable to measure the project success in virtual software development projects due to the third dimension. Virtual teams involve different collaboration across the organizations and it is required to identify the benefits as a result of the collaboration.

Therefore this framework as described in Table 2-1 is used in the current study to measure the project success.

Project success was measured along the dimensions suggested by Shenhar et al. (2001):

- Meeting planned goals (Efficiency)
- Impact on the customer (Customer's perspective)
- Benefit to the developing organization (Organization's perspective)
- Overall success was based on averaging the three success measures

Table 2-1: Project Success dimensions

Success Dimensions	Success Measures
Meeting planned goals	Scheduled goals Budgeted goals
Impact on the customer	Met functional requirements and specifications Answered customer's needs Customer was satisfied
Benefit to the developing organization	Created a new market Created a new product line Created new technological capabilities
Overall success	Created new operational capabilities

2.5 IMPACT OF DECISION MAKING ON PROJECT SUCCESS

Based on the reviews of the project success criteria literature, it is evident that several researches were identifying different success factors, on different perspectives. This was further supported by Fortune and White (2006) who demonstrated clearly that

there is lack of consensus between authors and researchers regarding what factors affect project success. Even though they found that the three most cited factors are: the importance of a project receiving support from senior management; having clear and realistic objectives; and producing an efficient plan, perhaps their most interesting finding is that there is a lot of overlap between sets of success factors but the factors selected for inclusion in individual lists vary to a considerable extent.

Accordingly, a model, the formal systems model (FSM) (Bignell and Fortune, 1984) were used as a framing device to deliver the benefits of taking into account of the success factors that were culled in the literature review whilst overcoming problems associated with their use. In other words, their research shows that it is possible to map most success factors with the features of the FSM model. The model is illustrated in Figure 2-2.

Overall, this stresses the importance of creating an environment in which projects can succeed rather than focusing on the success of single projects. It also brings attention to the strategic importance of linking project management effort to long-term organizational effectiveness. Additionally, although most studies emphasize different success factors, there seem to be relative consensus on the importance of human factors or "people" for successful project outcomes (Lechler, 2000). The "discovery" that performance and success is achieved through people draws attention to the role of individuals and their relationships in the project process. This implies that the management of people; i.e. the ability to influence, encourage and motivate individuals and teams, is becoming a necessary skill among the present and future project mangers (Pryke and Smyth, 2006). In light of this, a diversified and much more holistic understanding of project success is necessary, particularly in settings where practitioners must manage multiple projects at various stages of their life cycles and face competing priorities on a daily basis (Jugdev and Muller, 2005; Morris, 2006). As a response to this a number of authors have argued that project success and failure can be best understood and dealt with through the use of systems. This line of research places the spotlight on the connection of "hard" (e.g. cost, time and to specification; physical resources) and "soft" (e.g. multiple perspectives, communication, emotional intelligence) factors and the wider managerial and social frameworks within which individuals work in making sense of project outcomes.

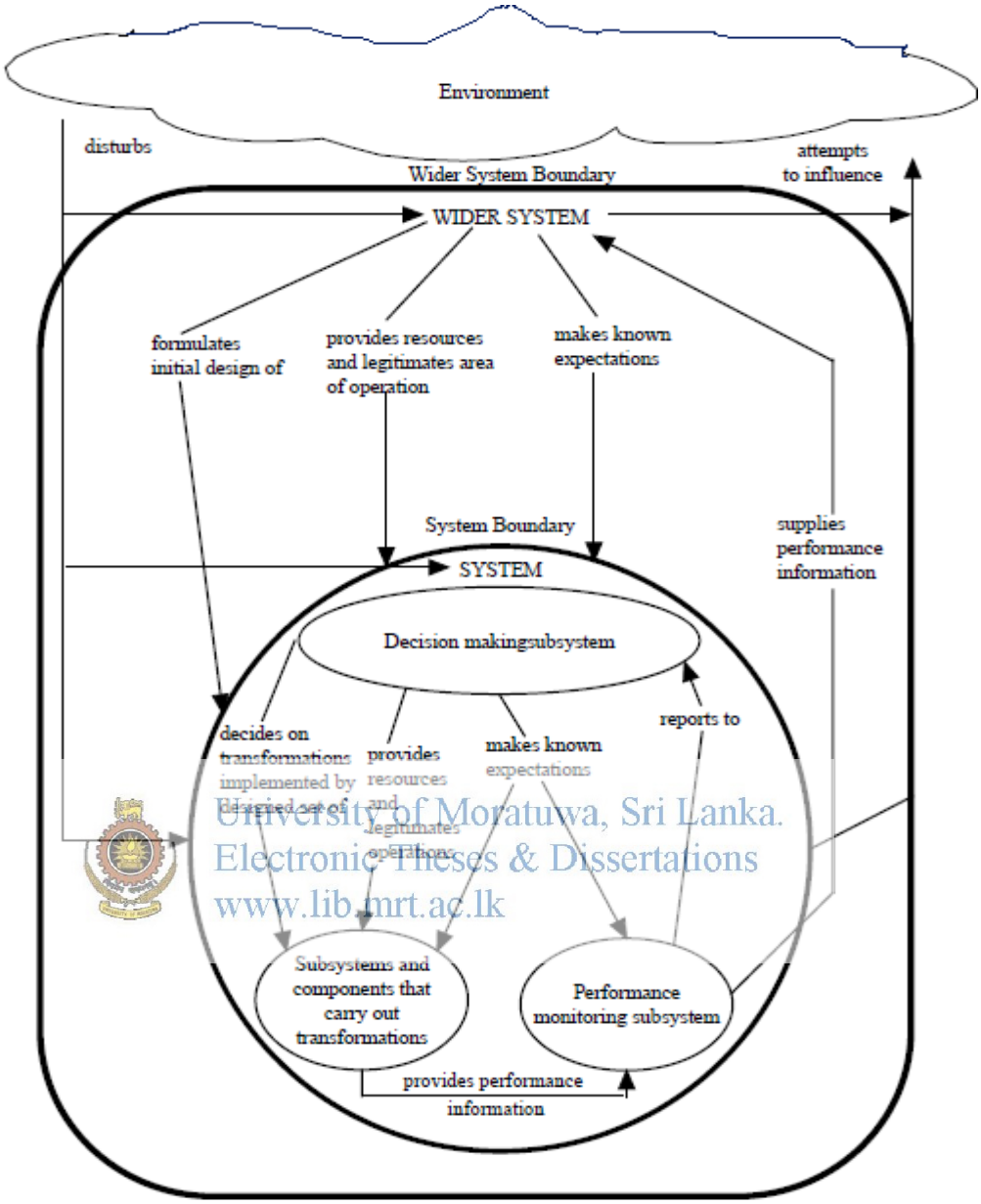

Figure 2-2: Formal Systems Model

Source: Fortune and White (2006)

Project management is the art of making right decision. Project managers face huge array of choices. Should different supplier be used to improve the quality of a product? Should additional team member be brought in to improve the development performance? Should the work be outsourced or done in-house?

Most important components of decision making process are integrated into project management processes in all knowledge areas. Analysis of potential alternatives is the

part of each stage of the project. Assessment of uncertainties is the part of project risk management process. Recent researches showed that well established decision making process integrated into overall project management significantly improves project performance (Ashley et al., 1987).

However, project management is more complex. Bringing a project to a successful conclusion requires the integration of numerous management functions such as controlling, directing, team building, communicating, cost and schedule management, technical and risk management, conflict and stakeholders management and life-cycle management, among others. The large variety of tasks has gradually fostered the 'systems approach' to project management, aimed at helping managers to understand the intricate nature of a project and capturing it as a 'whole'. Unfortunately, the theory did not develop at the same pace as the multi-faceted, multi- variable nature of modern project management (Baker and Nurphy, 1988). Consequently, the complexity and breadth of project management requires a broader investigative perspective.

However, the empirical study done by Dvir et al. (1998) on 'a non-universal approach to project success factors' mentioned that list of project success factors are varying with type of projects. Consequently, project managers must identify those factors that are critical to their specific project. They further mentioned that software projects are particularly sensitive to a priori criteria for operational and decision effectiveness.

It is understandable from reviews in earlier sections that to create as much value as possible during a software project economically balanced effective decisions have to be made. Then the question arises that how do PMR get effective decisions in software development projects? Firstly, they have to make all effects of a decision transparent. Secondly, all Stakeholders have to be involved in the decision process in an adequate way (Omasreiter, 2007). To do this, several approaches are available. According to Omasreiter (2007), a simple approach is presented to reach more effective decisions (compared to former approaches) in software development projects in the area of process improvement. This "value-oriented process improvement approach" has been implemented in three automotive software engineering projects at the Mercedes Car Group in order to make more effective

decisions. The value-oriented process improvement approach consists of three main steps as shown in Figure 2-3

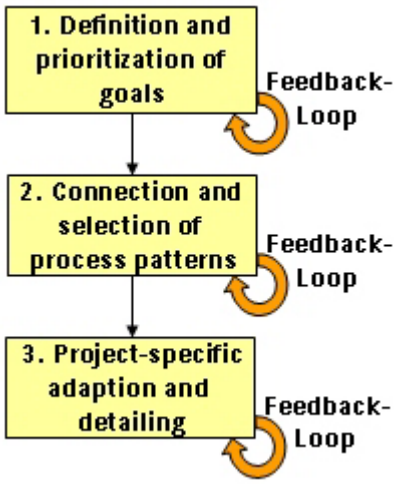

Figure 2-3: Value Oriented Process Improvement Approach

Source: Software Process Research

Step 1: Definition and prioritization of goals:

The first step of the value-oriented process improvement is the definition and prioritization of goals for the process improvement. To do this, the stakeholders of the resulting process have to be identified and asked for their goals and priorities. If there are several stakeholders, need a method to get a commonly agreed list of goals and their priorities. To get such an agreed list, several methods are thinkable, for example a voting process, or a simple common discussion meeting.

Step 2: Connection and selection of process patterns:

In this process step, possible process improvement actions has to be linked to the defined goals (implemented by a weighted connection matrix). To make the process improvement process as efficient as possible, the foundation of this step is a collection of process patterns. Each process pattern is a potential candidate for an improvement action. It is the goal of this second process step to select the "best" portfolio of process patterns out of the pattern pool. Whether process portfolio A is better than process portfolio B depends on a decision method that takes into account the efforts

and the benefits that the process portfolio causes with respect to the selected goal set. There are several decision methods possible.

Step 3: Project-specific adaptation and detailing:

After a process pattern portfolio has been selected, the selected patterns usually have to be more or less adapted and detailed according to the specific project environment. At the end the improvement, of course, actions have to be implemented in a reasonable sequence in the project. Each of the three process steps provides a simple, informal feedback mechanism that allows checking and, if necessary, optimizing decisions. Additionally, after the implementation phase it is recommended to regularly check if the goals are satisfactorily reached, or if there is need for changes in goals and/or process elements.

2.6 CONCEPTS RELATED TO DECISION MAKING

'Decision making' is usually defined as the act of choosing between alternative courses of action (Flynn and Williams, 1999). Effective decision making occurs when decision makers select the "best" course of action based on the information available at the time (Cooke and Slacke, 1984; Drummond, 1993). Since virtually every aspect of management involves some decision making, it is important to identify the different types of decisions managers take. Anthony (1965) distinguishes between operational, tactical and strategic decisions. Tactical decisions are taken by managers at the lowest level of the organisation and concern problems that arise on a daily basis; tactical decisions are taken by requirements project and process managers and relate to the operation of the main business functions of the software development organizations; strategic decisions are the responsibility of senior management and concern the future direction of the same organizations. The nature and complexity of decision-making varies according to the level of management. Although changes in the macro environment have increased the complexity of decision-making at all levels, managers at higher levels of the software development organizations are more likely to be involved in dealing with problems that are 'non-routine', i.e. require

higher levels of judgments than managers at lower levels where the problems that arise can often be dealt with by evoking 'routine' procedures (Simon, 1960).

Like many other management activities, project management can be seen as including a strong decision making component. Designing and executing projects in constrained timeframes generally results in pressure to make timely decisions concerning among other factors, activities, resources, and technology. From the perspective of limited rationality, a decision involves choosing between several alternatives. In every project, stakeholders who take part in conducting a project are compelled to make decisions in order to carry out their duties and meet their objectives. Doing so involves asking several relevant questions: Who should this task be given to? Who should be called to provide this information? In what previous project will relevant information be found? Which technologies should be used to satisfy this need? Which technical principle should be chosen for optimal reliability, while respecting the cost objective? The effectiveness of group decision making is an increasingly vital concern for organizations (Brodbeck et al., 2007). The act of defining and understanding decision making models is not an easy task. According to the work done by Mintzberg et al. (1976) people now understand the process and the mechanisms underlying decision making, whether these decisions are strategic or operational in nature. Although the management literature has a plethora of publications on the topic that have come out in the last decades, it is rather intriguing that the project management literature has not kept pace.

Most researchers and practitioners would readily agree that projects are particularly sensitive to how decisions are made within organizations. The short-term, one-time, specific nature of projects, as opposed to organizations' ongoing activities, often make the decisions that are made by project actors appear particularly critical and irreversible. In today's fast changing economic and technological environment, this phenomenon seems even more significant. When these factors are combined with the geographical and organizational distribution of project actors, decision making becomes a real challenge for practitioners, and authors such as Nidiffer and Dolan (2005) call for increased efficiency in that regard. The evolution toward virtual project management drives the need for improved processes, methods, and tools to input and share common data. The need applies across the project life cycle and

among all or selected elements of the team. In the global economy, there's a growing need to decrease the time it takes to make an informed decision, to improve the team's decision velocity. Such observations give rise to several questions that ought to be studied more thoroughly than they have been. In view of the increasing number of project teams acting simultaneously in several sites and with different cultural and organizational backgrounds, decision making needs to attract more attention as a central concept in projects, more specifically in the context of virtual project teams.

2.7 DECISION MAKING IN SOFTWARE DEVELOPMENT PROJECTS

Software development is an intense human capital activity, more intense in intellectual capital. Back in the nineties, organizations seeking lower costs and access to skilled resources began to experiment with remotely located software development facilities (Prikladnicki et al., 2003). As a result, software development became a multi site, multicultural, globally distributed undertaking.

Decision making is often identified with choice that is the selection of a specific course of action from among two or more alternatives in order to maximize the expected value of a decision (Rathwell and Burns, 1985). According to study done by Engleberg (2007) decision-making involves reviewing issues and making choices between alternatives.

Janis's (1989) research on factors affecting the decision-making of project managers indicates that individuals are often influenced by the views or likely reaction of their personal network: "Most policy makers are highly motivated to take account of affiliative constraints, they want to maintain or enhance their power, compensation or status within the organization and to continue to obtain social support from their personal network" (Janis, 1989). The desire for approval, and the need to exercise or maintain power, may thus influence decision-making behavior. The work of Roethlisberger (1939) and others demonstrates that individual decisions regarding the level of output may be determined by the norms of the group (Roethlisberger and Dickson, 1939); Stoner's research suggests that teams tend to take more courageous decisions than individuals acting alone (Stoner, 1968) while Janis's research

illustrates the impact of team norms and pressures to conformity on decision-making in critical situations (Janis, 1989).

In software development organizations, like other organizations, decision-making is influenced by the mission of the organization, its level of maturity, structural and cultural factors; and internally and externally generated change processes. With regard to mission, the types of decisions taken by managers obviously reflect the nature and purposes of the business. Managers who work in software development organizations for example are likely to take decisions that are similar to those in financial services or manufacturing firms both because the core business is the same and because the emphasis on profit generation is likely to lead to a same set of priorities. With regard to organizational maturity, research indicates that the longer an organization has been established the more likely it is to have developed complex procedures for handling problems and decision-making. It has been suggested in Flynn and Williams (1999) that such procedures may become so ingrained that they handicap the manager's ability to respond to volatility of requirements or to customer's changing requirements.

Structural and cultural factors also may have a significant impact on the decisions taken. The structure and culture of an organization are influenced by its corporate and departmental strategies. These help to define the organization's goals and guide future development. Decisions regarding the strategic direction of the organization influence the business rules that guide decision-making at lower levels of the organization (Williams, Hall and Kennedy, 2000).

Further, researches use the concepts of rational and naturalistic decision making to provide insight on software design decision making. Rational decision making (RDM) is characterized by consequential choice of an alternative and an optimal selection among alternatives (Lipshitz, 1993). To select an optimal alternative, three features are required. First, alternatives are represented by a set of possible courses of action and potential outcomes for each action. Second, a utility function assigns a value to each possible action based on the attributes of its outcome. Third, a decision has probabilities for which outcome will occur given the selection of an alternative. Consequential choice is the analysis of alternatives and potential outcomes, typical of rational decision theory (Lipshitz, 1993) while consequential choice is a main factor

of RDM, three other assumptions are also important. The first is the possible courses of action and the probability of specific outcomes are known. The second is a decision maker pursues optimality. The third is the large amount of time calculating alternatives is acceptable (Klein, 1998) Naturalistic decision making is defined by six characteristics (Klein, 1998). A naturalistic decision appears in dynamic and turbulent situations. It embodies fast reactions to changes and embraces ill-defined tasks and goals. A naturalistic decision is resolved under the guidance of knowledgeable decision makers. It uses situation assessment and has a goal of satisfying design alternatives, instead of optimizing them. Situation assessment is the evaluation of a single alternative. A decision maker exercises this alternative after determining it is "good enough" (Klein, 1998). Satisfying is the acceptance of a satisfactory alternative (e.g. "Good Enough Software").

2.8 DECISION MAKING IN VIRTUAL SOFTWARE DEVELOPMENT PROJECTS

Virtual project teams' decision making can simply be defined as the distribution of information and authority for decision making over several individuals or groups (Warkentin, 1997). In other words, virtual or distributed decision making is a term refers to the techniques which can easily be applied to the distribute setting by IT tools, such as sharing information, jointly creating contingency plans. Examples of decisions project teams make consist of how to utilize resources and when a product is ready to launch. Effectual and expeditious decision-making is vital to all types of project structures, the quality of which has a direct and significant impact on the success ability of the initiative. The availability of prerequisite information along with its accuracy and completeness are, for the most part, matters related to knowledge management and shared understanding (Haddad, 2007). The ability to make prudent, rapid decisions within the context of globally dispersed project teams is also dependent upon the use of group decision support tools and groupware (e.g. videoconferencing) to improve decision making (Engleberg, 2007; Qureshi, 2006). On the one hand, while computer-mediated decision-making allows the team to focus on objective rather than subjective information, there is an elevated risk directly related to making group decisions in a limited social context (Schermerhorn, 2005).

Risks associated with effective decision-making in globally, outsourced virtual project environments are most productively mitigated via video-conferencing, group decision support tools (e.g. electronic meeting system) and establishment of team trust, knowledge management, and shared understanding.

The quality and availability of information has a major impact on the s capacity to respond to requirements changes and customer satisfaction on decision-making. It seems reasonable to assume that virtual team members who have access to high quality information and used systems to support decision making are likely to make more effective software development process decision than those who do not have such systems.

Past researches were trying to understand decision making within virtual project teams focused on the decision making effectiveness of individuals, face-to-face teams, and virtual teams. For instance, through an empirical study of graduate students placed in a decision-making context related to new product development, Schmidt, Montoya-Weiss, and Massey (2001) demonstrated that decision-making teams, both face-to-face and virtual, make project review decisions more effectively than individuals acting alone. It appears that teams are less likely than individuals to continue projects whose outcomes appear dubious (Schmidt et al., 2001). As explained by these authors, teams are better than individuals at evaluating the feasibility and success of a project, so their members are less inclined to participate in risky projects. The team develops better control over the project because of the experiences, knowledge, and points of view contributed by each team member. Another important result of the Schmidt et al. study is that virtual teams appear to make more effective new product decisions than face-to-face teams. Two key factors help explain this finding. First, the authors posit that in virtual teams, the traditional social cues and mechanisms that facilitate human interaction and decision making are altered by the communication technology. Indeed, they indicate that the leanness and low social presence of the asynchronous communication environment (imposed in that case by Lotus Notes technology) contributed to more focused and objective decision making.

Conversely, authors such as Potter and Balthazar (2002) conclude that virtual teams show the same interaction styles as traditional teams (collocated teams, face-to-face)

and that these interaction styles have the same impact on tasks and performance. They suggest that individuals do not give up their personalities when they enter virtual teams; on the contrary, they display them in virtual teams as well as in collocated teams. Other authors, such as Duarte and Snyder (2001) find that a virtual team is more likely to succeed in a nonhierarchical, less authoritarian culture. This is supported by Kock (2000). However, Kahai et al. (2001) found that a virtual team is more successful with clearly defined and structured workflows and goals. In addition, Frame (1995) emphasizes, that a virtual project succeeds most often when team members have confidence in their leader and in each other, since virtual teams normally do not have the ability to assess each other's working habits visually. Finally, Hedlund et al. (1998) compared groups of students organized in hierarchical decision-making teams with distributed expertise. In these teams, members do not share the same expertise, and the leader must coordinate the decisions made to perform a task or find a solution. Consensus is not desirable or even possible because each member possesses different levels of knowledge. The authors suggest that, in the first phases of project development, the leader must initiate a flow of information that is useful for making individual decisions. However, when decisions depend on other members' expertise, social pressure prevents decision making from being efficient. Teams then take advantage of electronic communication tools to reduce this social pressure. While we recognize the value of the existing decision-making literature, and the literature on virtual team management, we find that more attention is still required at the project level and in the specific context of decision making within virtual project teams. Team autonomy is considered as a critical element of team performance and effective decision making factor in virtual teams (Campion, Medsker, and Higgs, 1993; Cohen and Bailey, 1997; Stewart and Barrick, 2000). Further, according to work done by Christian (2002) and Qureshi (2006) they have identified trust, knowledge management, and shared understanding are antecedents to effective decision-making.

Based on the above review of the literature, there are different factors that affect the effective decision making of virtual teams. It is the primary purpose of the study to build a comprehensive list of factors in the context of virtual teams and study the

relationship of these factors with decision making and subsequently their effects on project success. Following factors are identified.

Team autonomy

- Team competence for setting up own objectives
- Available resources and authority level
- Training availability

Management of socio emotional factors

- Coordination
- Trust
- Shared understanding and knowledge transfer
- Relationship building

Effective communication

- Tools of communication
- Motivation to communicate
- Level of project communication

2.8.1 TEAM AUTONOMY AS A PREDECESSOR OF EFFECTIVE DECISION MAKING

According to the researches of Stewart and Barrick (2000) and Langfred (2000) they define team-level autonomy as the extent to which a team has considerable discretion and freedom in deciding how to carry out tasks.

Further, team and project management literature, team autonomy is recognized as an important success factor (Hoegl and Parboteeah, 2006). Thus, decentralization of decisions within the distributed team members should prevail, especially in contexts where a quick response to changing technologies and environments is necessary (Zabojnik, 2002). Despite the importance from a team's perspective of preserving its autonomy, organizations tend to interfere with team autonomy for many reasons. Sometimes, team decision making discretion is withdrawn because top management

does not share an understanding of the product development process. This interference may take the form of higher levels of management that they be consulted for major or minor operational decisions. Other reasons are that managers may not buy into the concept of team autonomy (Gerwin and Moffat, 1997). While some forms of management interference can be beneficial because these provide feedback to help project completion or encourage creativity within the team by discouraging groupthink, some researchers argue that team-external influence over project decisions is detrimental to teamwork in projects (Hoegl and Parboteeah, 2006). Virtual projects involve high levels of uncertainty and ambiguity, along with a crucial need to solve problems. Such information sharing and task coordination within the team is likely reduced when top management interferes with project decisions. Drawing from the information processing perspective on the organizational level (Daft and Lengel, 1986), such hierarchical structures linking team members and top management decrease collaborative processes within the team, as communication increasingly flows vertically (from top management to the team) rather than horizontally (within the team). If a team has a high degree of autonomy over project decisions, team members rely upon themselves for task decisions, which will likely increase the sharing of information and the coordination of task activities horizontally within the team. Top management influence on project decisions may signal to team members that management does not buy into the team autonomy idea (as mentioned earlier) or does not trust the team to be able to make such decisions. Both cases are likely to result in team members' being less satisfied with the team (Kirkman and Rosen, 1999) and less committed to the team, thereby undermining their feelings of authority, responsibility, accountability, and consequently reducing the quality or effectiveness of their teamwork. Team members who can influence the decisions that affect them are more likely to value the outcomes, which in turn reinforces satisfaction (Black and Gregersen, 1997). The highest satisfaction comes with high-level involvement, as occurs when team members are involved in generating alternatives, planning processes, and evaluating results. Given all the above features, team autonomy over project decisions should lead to better effectiveness and decision-making quality. Such evidence should be emphasized in the particular

context of distributed projects, as the nature of these projects involves higher levels of uncertainty and ambiguity.

Under this concept, various researches talked about three indicators such as team competence for setting up own objectives, available resources and authority level, training availability. The degree to which teams were involved in managing their own work activities was based on Little (1989) and Sprigg, at el (2000). Examples for items included "Are team members themselves involved in making decisions about setting goals and targets?" and "Are most job-related decisions made by team members rather than by just the shift manager?"

2.8.2 MANAGEMENT OF SOCIO EMOTIONAL FACTORS AS A PREDECESSOR OF EFFECTIVE DECISION MAKING

The relationship building, cohesion, trust, coordination and knowledge sharing are presented as the fundamental socio-emotional processes to foster the effectiveness of the virtual team decision making, however; teams face significant difficulty in achieving them (Alexander, 2000; Kezsbom, 2000).

Trust has been defined as the "willingness of a party to be vulnerable to the actions of another party, based on the expectation that the other will perform a particular action important to the person in whom trust is placed, irrespective of the ability to monitor or control that other party" (Mayerson, et al., 1996). The issue of trust is very important particularly in the context of virtual teams because virtual team members are "geographically dispersed" and lack "shared social-context" and "face-to-face encounter" that are considered by many researchers as irreplaceable for building trust and repairing shattered trust (Jarvenpaa and Leidner, 1999). Trust development in virtual teams also presents significant challenges because it is difficult to assess teammates' trustworthiness without ever having met them (McDonough et al., 2001). Moreover, trust must quickly develop as the life of many virtual teams is relatively limited (Jarvenpaa and Leidner, 1999). Jarvenpaa et al. (1998) measured the antecedents of trust using experiments conducted in an academic setting and proposed a preliminary model of trust in the context of global virtual teams. Sarker et al. (2003) developed a comprehensive instrument for measuring different types of trust.

Virtual teams tend to have more of a task focus and less of a social focus than traditional teams, but over time they also appear to lessen their task focus (Chidambaram and Bostrom, 1990). Virtual teams generally build weaker relation links to teammates as compared to the traditional teams, a fact which is attributed to the significant reliance of electronic communication and difficulties associated with those communication modes (Sproull and Keisler, 1986). However, virtual teams require more social communication to achieve higher trust and better social and emotional relationships (Robey et al., 2000).

Cohesion is an important aspect of the virtual team. Cohen and Bailey (1997) suggest that cohesion is a critical factor influencing the effectiveness of groups/teams. They also concluded that a primary factor leading to team cohesion is the degree of trust among team members. Several studies have focused on cohesion by comparing virtual teams with traditional teams. However, results have been mixed. Warkentin et al. (1997) found that collaborative technologies hindered the development of cohesion in virtual teams and, hence had lesser levels of cohesion compared to traditional collocated teams. However, cohesion is presented as an important aspect of virtual teams since it is related with better performance and decision making (Chidambaram and Bostrom, 1990). Studies have found that while virtual teams begin with lower cohesion as compared to traditional teams, over time virtual teams also exchange enough social information to develop strong cohesion. Without having met with team members, trust development in virtual teams is also very challenging (McDonough et al., 2001). Hence without managing these socio emotional factors, team members are not comfortable with the environment when making project decisions.

Coordination represents the degree of functional articulation and unity of effort between different organizational parts and the extent to which the work activities of team members are logically consistent and coherent. Ebert and Neve (2001) specify three important terms; coherence, collocation, and allocation, related with the coordination of remote sites, and allocation. Coherence means splitting the work during development according to feature content and assembling a team that can implement a set of related functionality. Collocation means that engineers working on such a set of coherent functionality should sit in the same building. Full allocation means engineers working on a project should not be distracted by different tasks in

other projects. The article of 'Surviving DSD' of Ebert and Neve (2001) emphasize the challenge of virtual teams in providing strong communication and coordination practices because of the difficulty in supplying those important terms. The coordination problems are directly related with decision making in the virtual teams. The major sources of problems are interdependencies among work items and difficulties in coordination. The interdependencies may arise if the architecture of the system does not involve relatively independent modules that can be assigned so that they do not span locations (Mockus and Herbsleb, 2001). The strategic issue involves the questions of how to divide up the work across sites. Solutions are constrained by the resources available at the sites, their levels of expertise in various technologies, the infrastructures etc. Herbsleb and Moitra (2001) suggest that an ideal arrangement would let the sites operate as independently as possible while providing easy, flexible, and effective communication across sites. The coordination becomes an issue because of process non-uniformities, such as variances in the definitions may cause mismatched expectations and conflict. They also suggests several pitfalls in VSD which may arise from lack of differences in infrastructure in different development locations, including network connectivity, development environment, test and build labs, and change and version management systems (Herbsleb and Moitra, 2001).

Effective information and knowledge sharing mechanisms are also one of the essences of virtual software development projects. Because of the ineffective knowledge management practices, needed expertise might be available but cannot be located and exploited, managers fail to share information from the customers and development teams, teams cannot determine the tasks of critical path, and teams miss many reuse opportunities to save cost and time (Mockus and Herbsleb, 2001).

2.8.3 EFFECTIVE COMMUNICATION AS A PREDECESSOR OF EFFECTIVE DECISION MAKING

At the core of any virtual team process is communication. Numerous articles in the practitioner press discuss the importance of communication focusing on the need to create a team of excellent communicators, and on the selection of the right technology

for most effective communication in virtual teams. As noted by Hulnick (2000) "if technology is the foundation of the virtual business relationship, communication is the cement" (Hulnick, 2000). The virtual environment presents considerable challenges to effective communication including time delays in sending feedback, lack of a common frame of reference for all members, differences in salience and interpretation of written text, and assurance of participation from remote team members (Crampton, 2001). Moreover, nonverbal communication, an important component of team communication, is usually missing in virtual teams. Sproull and Kiesler (1986) point out that technology tends to restrict the communication process because electronic media are intrinsically leaner than face-to-face communication and convey a limited set of communication cues.

Thus, teams operating in the virtual environment face greater obstacles to orderly and efficient information exchange than their counterparts in the traditional context, a difficulty that is compounded when the virtual team is global in nature. Paul et al. (2005) defined items for perceived participation and communication in the context of collaborative conflict management exercises. Piccoli et al. (2004) analyzed team member communication on the effectiveness of virtual teams and indicated that the most satisfied team members were in virtual teams with effective coordination and communication.

Effective communication is a vital process in every organization and is an essential element for successful virtual software development. Fear and motivation directly impact on the level, content, and effectiveness of communication and the use made of communication tools. Individuals have to be motivated to use the tools which are provided and these must be adequate to efficiently do the job. As a result the level of communication which takes place, it must be adequate to meet the needs of the specific teams and projects.

Communication technologies used to support virtual groups include electronic mail, computerized conferencing, and videoconferencing (Chidambaram and Jones, 1993; O'Conaill et al., 1993). Group process support provided by communication technologies include idea generation, problem solving information exchange, conflict resolution, negotiation, and decision making. These communication technologies

allow organizations to form virtual teams by dissolving the boundaries that separate groups. In addition, these virtual teams can be instantly dissolved.

Empirical findings on technological support for team work have suggested that communication technology facilitates team process through enhancing group problem solving capabilities, improving team interaction, and reinforcing satisfaction with the task process and the evolving solution (Alavi et al., 1995; Chidambaram and Jones, 1993; Nunamaker et al., 1991). It is suggested that software development, when perceived as a collaborative problem solving process, is certainly dependent upon the team process experienced by work teams engaged in that activity. Hence, communication technologies give rise to potential collaborations among virtual workgroups and virtual organizations.

The results from the study conducted Casey (2010) it highlighted the importance that communication played in the successful operation of virtual software teams. The requirement for the selection of adequate communication tools was highlighted as was the importance of providing training in their use. The need for a comprehensive communication procedure was identified. The importance of utilizing synchronous rather than asynchronous communication tools was recognized. It was also noted that the excessive use of email could lead to delays.

Empirical work done by Mockus and Herbsleb (2003) effective communication is measured under two dimensions as social presence and media richness. Social presence refers to the ability of a communication medium (e.g. e-mail, or videoconferencing) to allow the group members to feel the presence of a communicator. Media richness refers to the extent to which communication medium can provide immediate feedback, the number of cues and channels utilized, backchanneling cues, and socio-emotional content in a communication session. Communication mediums can be differentiated in terms of the extent with which they facilitate social presence. For example, videoconferencing permits the transmission of multiple channels of communication for exchanging verbal, nonverbal, and visual cues, and socio-emotional content during a communication session. However, O'Conaill et al. (1993) noted that during conversations over videoconferencing:

1) Listeners produced fewer backchannels and interrupted less often

2) Turn endings were not adequately anticipated

3) The handover of turns was formal.

Walz et al. (1993) noted that an effective software development group process involves knowledge acquisition and the sharing and integration of that knowledge. Software design teams must acquire knowledge regarding the problem domain, user requirements, and design approaches. Consequently, the communication medium used during systems analysis and design can impact software project outcome (i.e., task and psychosocial outcomes) depending on the extent of social presence and media richness associated with the communication medium. Media richness is essential to the support of information exchange of user requirements, negotiation of the final design, and satisfaction with design solution. As a result, media richness should be positively associated with software development task outcomes. In addition, media richness is associated with higher social presence which suggests that psychosocial task outcomes may be reduced. Social presence theory suggests that through the lower social presence-increased participation relationship, project team members should experience a greater sense satisfaction with the socio-emotional aspects (e.g., negotiation and equality of participation) of the team work.

Instant Messenger, Skype, video conferencing and bespoke Internet based communication and operational tools are used in most virtual collaborations. As a consequence, there has been a substantial reduction in the cost of international communication (O'Conaill et al., 1993). Taking these factors into consideration the rationale for the adoption of a VSD strategy has been attributed to organizations endeavoring to gain and maintain competitive advantage (Prikladnicki et al., 2003). It is believed this can be achieved by capitalizing on the perceived advantage of labor arbitrage between geographical locations. This can then be coupled with leveraging the temporal difference between these locations which can provide opportunities for reduced time to market and facilitate competitive pricing. Increasingly organizations are endeavoring to leverage these opportunities to enable them to establish, maintain and / or expand their market share in what are often volatile international markets.

Motivation is defined as the excitement level and the drive to work in a virtual team project. If the virtual team members feel challenged by the project work, the performance will show improvement (Lurey and Raisinghani, 2001). It also encapsulates the purpose and the direction of behavior of team members to work with remote team members.

2.9 CONCLUSION

This chapter has reviewed the existing literature on decision making effectiveness in virtual project teams, various factors that influence on decision making and concepts related to virtual project success. It also reviewed the effective decision making as a key success factor of virtual project success. However, considering the comprehensive literature, it is evident that different authors have investigated different factors on the decision making effectiveness and project success in virtual teams in general. Still there is a lack of researches on country context and specific to an industry such as software development which use virtual teams at a higher rate. Therefore, the literature confirms that it is crucial to explore, identify and understand the factors, systems and processes that could support and affect decision making in virtual software development teams to a country like Sri Lanka which still denoted as a developing country in the world.

Moreover although there is a considerable literature on managerial decision making, few researches have been published on the influential factors on effective decision making within the virtual software development projects. This research is backed by identified determining factors and aim to find out whether those factors will actually have an impact on the decision making virtual software development project teams.

The review explores the determining factors of effective decision making in order to achieve the first research objective. The review indicates that most influential determining factors of effective decision making are team autonomy, management of socio emotional factors and effective communication. This review also stresses indicators of each of these factors as predecessors of effective decision making. Then

it reviews the impact of effective decision making on the project success to build up a strong foundation to the testing which was conducted in this study.