Master Thesis in Software Engineering and Management

Making Management Commitment Happen in SPI

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Göteborg, Sweden 2007

Department of Applied Information Technology

REPORT NO. 2007: 116

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De-motivators, Motivators and Indicators of Management Commitment in Software Process Improvement Effort

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ISSN: 1651-4769

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SUMMARY

Today many organizations are seeking software process improvement (SPI) to improve their organizational capacity to deliver quality software. Last two decades have seen a proliferation of SPI models and methodologies. But SEI statistics yet indicate the failure of the most of the companies to achieve their process improvement goals. An analysis of SPI literature suggests that management commitment is most frequently cited success factor in this regard. Thus making management commitment happen in SPI has emerged as an essential factor in SPI success. Extant SPI literature has explored some aspects of management commitment, nevertheless prime question is un-answered that how SPI practitioners cope with this challenge.

Addressing this question we conducted this study that is based on qualitative interviews and questionnaires with sixteen SPI practitioners in fourteen software organizations across Sweden, Pakistan, USA, France and Canada. It reports motivators, de-motivators and indicators of management commitment. The findings of this study can help SPI practitioners in designing SPI initiatives that will render enhancement in management commitment. Furthermore, this study implies that any SPI research conducted in a specific context can lead to inconsistent results due to cultural impacts.

The report is written in English.

Keywords: SPI, Management commitment, Motivators, De-motivators, Indicators

Acknowledgements

I would like to thank all of my respondents, without their cooperation this study would have been impossible. I am extremely grateful to my supervisor Rikard Lindgren for his incredible support, encouragement and guidance during this study. Special thanks are also due to my friend Muhammad Umair Aslam for his help with English language of this manuscript.

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1. Introduction

1.1 Background

During the last few decades software has played an ever increasing and critical role in the life of human beings. We became more dependent on software than ever before. The overwhelming role of software led to complexity of software development. One software bug may cause big financial lose or failure in space mission and even it can be disastrous for human life. In 1994 the Standish Group initiated a study on 8380 software development projects regarding software project failures. “It concluded that 53% projects were challenged, i.e., increased cost, missing deadline and lacking required capabilities. While 31% were canceled before completion and only 16% were successful, i.e., met deadlines successfully, completed within budget and with required capabilities” (Ross, 1998). To survive with dynamic organizational needs and attain customer satisfaction have emerged as a challenge in the present era (Abrahamsson, 2001). In order to cope with these issues and increase the capability of the software organizations, software process improvement (SPI) initiatives are being taken (Abrahamsson, 2001). Last twenty years have seen a revolution in form of methodologies and models in SPI e.g. CMM, CMMI, SPICE, TickIT, QIP, Agile Methodologies and Six Sigma etc. (Serrano, 2004).

In return, many success stories of process improvement have been reported in SPI literature. For example, IBM (Nichols & Connaughton, 2005), Hughes (Humphrey et al., 1991), Motorola (Daskalantonakis, 1992), NASA (Basili et al., 1997), Philips (Rooijmans & Aerts, 1996), Raytheon (Dion, 1992), and Siemens (Mehner et al., 1998) have reported successful implementation of their process improvement goals. Whereas on contrary, maturity profile of software community provided by Software Engineering Institute (SEI) suggests that most of the companies fail to make SPI happen. If we consider the maturity profile of software community produced by SEI in March 2006 (MPS, 2006). It shows that out of 3049 organizations only 704 organizations were re-assessed. It is 23% of total organizations. Out of re-assessed organizations; 12.5% did not improve and 2.8% moved down. We wonder; why is it hard to make SPI happen yet.

An analysis of SPI literature reveals the influential stature of some factors over success of SPI (Niazi et al., 2006). The most frequently cited success factor is management commitment (Stelzer & Mellis, 1998). Several case studies and experience reports from SPI practitioners have acknowledged key importance of management commitment (e.g., Basili et al., 1997; Curtis, 2000; Dangle, 2005; Ogasawara et al., 2006; Hara, 2006; Hardgrave, 2005; Salvaneschi et al., 2006). Similarly researchers have also considered management commitment as a vital aspect for the success of SPI (e.g., Abrahamsson, 2001; Börjesson, 2006; Dybå, 2005; and Weigers, 1998). Goldenson and Herbsleb (1995) have reported that SPI efforts are threatened and challenged by several factors and most of them are under management control. Stelzer and Mellis (1998) have placed management commitment at first either in CMM or ISO cases by the analysis of 56 SPI case studies. Their analysis has disclosed that management commitment has been reported as an essential factor in 84% of the ISO cases and 97% of the CMM cases.

Prior research has investigated some aspects of management commitment as follows (more details are presented in section 3.4). The SPI motivators and de-motivators for management have been reported in a study conducted with senior managers (Baddoo & Hall, 2002; 2003). Some methods to measure management commitment have also been suggested (Börjesson, 2006; Abrahamsson, 1999). Abrahamsson (2000b) has presented a theoretical framework of management commitment process based on psychological, sociological and organizational behavior literature. But still curiosity remains that how SPI practitioners cope with this problem. Extant SPI literature lacks any research effort that has addressed this aspect. It is an important area to be investigated since SPI practitioners are considered responsible to make SPI happen in any organization.

Addressing this research gap, the present study based on qualitative interviews and questionnaire with sixteen SPI practitioners in fourteen software organizations across Sweden, Pakistan, USA, France, and Canada. It reports de-motivators, motivators and indicators of management commitment.

1.2 Research Questions

Following three research questions were formulated based on the above mentioned background.

RQ1: What are the reasons that lead to lack of management commitment?
RQ2: What are the motivators for management commitment?
RQ3: What are the indicators of management commitment?

1.3 Structure of the Thesis

The thesis is structured as follows. *Chapter 1* (Introduction) is followed by *Chapter 2* (Software Process Improvement). Description of evolution of SPI and success factors of SPI is provided in this chapter. *Chapter 3* (Management Commitment in SPI) presents definition of management commitment, role of management commitment in SPI and prior research regarding management commitment. *Chapter 4* (Method) describes the methodology employed for this study. In *Chapter 5* (Results), findings of this study are presented. *Chapter 6* (Discussion) discusses our findings in comparison of prior research and possible future work is also presented. *Chapter 7* (Conclusion) precisely presents outcomes of this study.

2. Software Process Improvement

2.1 Defining SPI

IEEE has defined process as “a course of action to be taken to perform a given task”. (IEEEStd-610, 1990). Likewise, a number of phases are also involved in case of software development. Generally, different phases of software development can be outlined as: requirement gathering, designing of product, development and testing. The procedure involving numerous activities for the development of software can be termed as *software process*. “A software process can be defined as a set of activities, methods, practices, and transformations that people use to develop and maintain software and the associated products (e.g., project plans, design documents, code, test cases, and user manuals)” (Paulk, 1993)

Today, complexity of software development is well known and often it ends up with the undesired and unexpected results (Fuggetta, 2000). Public risk has been raised up highly in case of any software malfunctioning due to enhanced computerization of the society (Humphrey, 98). Software quality depends upon quality of software process (Fuggetta, 2000). Thus, with the evolvement of mature software process, probability of the development of good quality software can be increased. The objective of SPI is to improve organizational capabilities to deliver quality software by following defined processes or systematic procedures (Pourkomeylian, 2002).

2.2 Evolution of SPI

What we know today as SPI has been evolved from the ideas of quality gurus like Shewhart, Deming and Juran in early 30s (Dybå, 2005). It is impractical to provide an exhaustive and technically complete overview of all body of knowledge. Thus my focus is to provide an overall picture of SPI by presenting a decade-by-decade synopsis of SPI evolution. It includes contributions of both academia and practice. Little attention has been paid to SPI as an extensive research area in academia (Card, 2004) and most of the research efforts have been made by the industry (Serrano, 2004). Thus, any retrospective analysis without considering contributions of industry will be considered incomplete.

1930s	Shewhart introduced statistical process control, control chart and cycle for quality improvement.
1950s	Edwards Deming and Joseph Juran elaborated and enhanced ideas of Shewhart. Juran introduced Quality Trilogy theory.
1960s	Evolution of IBM’s manufacturing process improvement concept
1970s	Philips Crosby proposed maturity grid Software development life cycle was introduced

1980s	IBM's Process Grid Process Maturity Grid Deming's 14 principles of quality ISO 9000 TickIT Six Sigma
1990s	IDEAL Model CMM for software ISO 9000-3 SPICE (ISO 15504) QIP Success Factors of SPI
2000s	CMMI. TSP Pries-Hej and Tide Workshop Agile Methods in SPI

Table 2.1: Overview of SPI evolution through decades

In **30s,** Walter Shewhart introduced control chart and principles of statistical quality control. These are considered basis for all existing principles of quality control (Shewhart, 1986). Control chart provides means to control the quality of a manufacturing process (Shewhart, 1986). Shewhart also proposed cycle of quality improvement PDS (Plan, Do, See) (Shewhart, 1931).

In **40s,** quality control techniques and statistical process control were not widely used in the manufacturing industry. In late 40s Deming and Juran addressed the quality concerned issues in more depth which earned popularity in Japan that was suffering due to the low quality products in international market those days. It was the start of a golden period of total quality management (Powell, 1995).

In **50s,** Edwards Deming and Joseph Juran elaborated and further developed the ideas of Shewhart. Edwards Deming's theories enormously impacted Japanese manufacturing and business industry. His theories led Japanese industry from chaos to become pioneer in quality products (Rafael, 1991). Deming further improved the cycle of quality improvement PDS proposed by Shewhart (Shewhart, 1931) into PDCA (Plan, Do, Check, and Act) (Figure: 2.1)

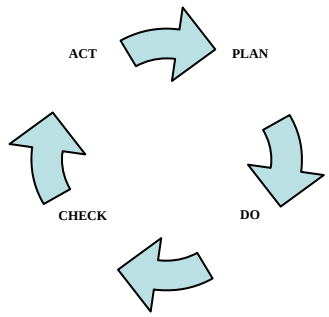

Figure 2.1: Deming's PDCA cycle for quality improvement (Shewhart, 1931)

The cycle consists of four phases: plan, do, check and act to improve the quality. Deming presented fourteen principles for managers to achieve business success (Deming, 1986). Joseph Juran had belief that "quality does not happen accidentally". This belief led him to quality trilogy theory (Juran, 1986). It consists of three sides: quality planning, quality improvement, quality control.

In **60s,** IBM's manufacturing process improvement concept (Radice et al., 1985) was thrived which became foundation for Crosby's 'maturity grid'.

In **70's** Philips Crosby proposed 'maturity grid' (Crosby, 1972). It was actually an organizational maturity matrix. The 'maturity grid' consisted of five stages i.e. uncertainty, awakening, enlightenment, wisdom, and certainty. Crosby proposed 'four absolutes of quality' (Crosby, 1972). Moreover, he set a new perspective of quality by suggesting that quality is conformance to requirements instead of elegance of some thing. He changed classical notions about quality by declaring that "the intent of quality should be prevention instead of appraisal and performance level should be zero defects" (Crosby, 1972).

Royce (1970) introduced software development life cycle concept. Conventionally software development was divided into two steps that were analysis and coding. But, Royce (1970) presented software development life cycle consisting of several stages of software development. The software development process consisted of different phases and stages like system requirements, software requirements, analysis, program design, coding, testing and operations. The software development model is known as waterfall model currently. In fact, all of the phases were in practice more or less, but had not yet been recognized as distinct phases. The approach to visualize software development as a process helped to understand concerned problems and issues to software development (Fuggetta, 2000). Furthermore, it led to consider organizational, cultural and economical factors associated with software development (Ghezzi, 1998). Later on, it was followed by many software development models like spiral model, evolutionary models, RAD, and RUP etc.

In **80s,** quality models and improvement methods were focused more intensively which was based on recognition of software development as a process and other soft issues associated with it (Ghezzi, 1998). IBM's process grid (Radice et al., 1985) was proposed that was based on the early maturity grid proposed by Crosby in 70's. Watts Humphrey adopted IBM's process grid to software processes and introduced maturity levels into it and named it as 'process maturity grid' (Humphrey, 1987). Ishikawa (1985) emphasized organizations to use seven quality control tools, i.e., process flow charts, check sheet, histogram, pareto chart, cause-effect diagram, scatter diagram, control chart.

International Standard Organization (ISO) (ISO, 1987) introduced a new standard 'ISO 9000' for quality improvement in 1987. TickIT (TickIT, 1988) was also initiated by ISO in 1988. The adoption of a standard and acquisition of certification was considered a guarantee that the company could deliver quality products (Ghezzi, 1998). Thus more and more companies took interest in adoption of ISO standards. The main focus of these standards was on the management of different activities and procedures to deliver a quality product and was lacking guidance to improve

processes (Ghezzi1998). In late 80's software process maturity framework was introduced by SEI that addressed these issues. It rapidly earned popularity in the industry. Humphrey (1989) introduced evolutionary approach for software improvement. The approach suggested that an SPI initiative should be started from diagnosing problems, processes should be designed to address these problems thereafter. In mid 80's Motorola developed Six Sigma (SixSigma, 1986). Six Sigma methodologies provide the techniques and tools to improve the capability and reduce the defects in any process. Quality Improvement Paradigm (QIP) (Basili & Weiss, 1984) suggested a roadmap for SPI implementation; in terms of following six steps: (1) Characterize & Understand, (2) Set Goals, (3) Choose processes, methods, techniques and tools, (4) Execute the process, analyze interim results, and provide real-time feedback for corrective action (5) Analyze Results, and (6) Package and store experience

The decade started with realization of importance of process improvement to achieve better quality. It was followed by development of new models for process improvement and methodologies.

In **90s** too, there was a wide proliferation of methods and models for process improvement. Many SPI models were introduced, i.e., ISO 9000-3, SPICE, BOOTSTRAP. Humphrey's (1987) 'process maturity grid theory' was transformed into software process maturity framework. It was evolved by modifications in KPAs at different maturity levels and finally came up as the capability maturity model (CMM-SW) (Paulk, 1993)

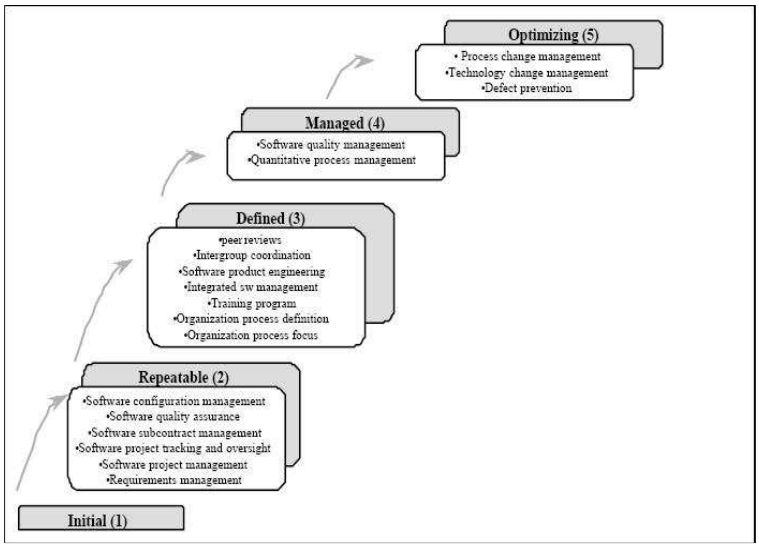

Figure 2.2: The CMM Model and the Five Maturity Levels (Paulk 1993)

CMM provides a process improvement approach for organization through five maturity levels, in order to measure its process improvement capability. These include Initial, Repeatable, Defined, Managed, and Optimizing.

Unlike 'top-down' approaches (e.g. CMM, SPICE), GQM (Basili et al., 1994) is a 'bottom-up' approach. GQM suggested improvement through measurement. This paradigm provided a three step framework: Goal, Question and Metric.

Though, there was a wide proliferation of tools and technologies but still many organizations were seeking that how to implement these models and methodologies. There was lack of implementation guidance for these models and methodologies. In this response IDEAL model (McFeeley, 1996) was introduced by SEI.

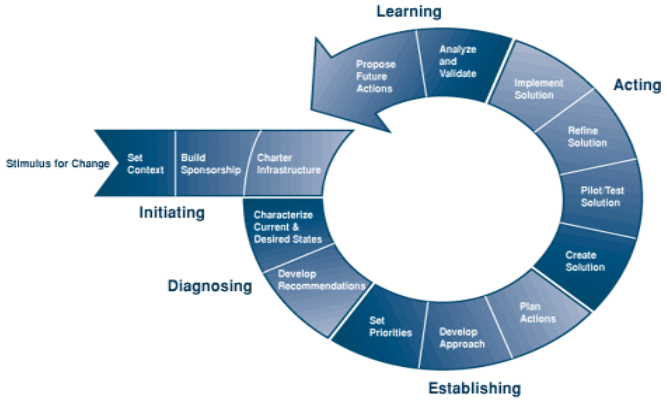

Figure 2.3: The IDEAL Model for SPI (Mc Feeley, 1996)

This model provides guidance for the implementation of SPI. It provides five phase approach for SPI implementation, i.e., initiating, diagnosing, elaborating, establishing, acting, and leveraging.

In 90s, though there was wide proliferation of models and methodologies but researchers and practitioners started to pay some attention to success factors or barriers of process improvement as well.

In **2000s,** CMMI (CMMI, 2002) has been released by SEI that extended CMM's practices. Mainly CMM focused at software engineering whereas CMMI has integrated system engineering with software engineering. It has five maturity levels i.e. initial, managed, defined, quantitatively managed, and optimizing (CMMI).

Fichman and Kemerer (1999) identified an assimilation gap elaborating difference in what we acquire and what we deploy. In order to fill up this assimilation gap Pries-Hej and Tide (2001) proposed a workshop scheme for designing an implementation strategy as a solution to assimilation gap. This workshop consisted of six different activities that could help to successful deployment.

Now-a-days software organizations undergo frequent changes that lead to unpredictable conditions (Börjesson et al., 2006). So, it is not possible to take long term initiatives. There were traditional SPI approaches like QIP, IDEAL. In order to cope with these situations agile methodologies were introduced in software process improvement (Börjesson et al., 2006). It suggested taking small improvement initiative and then proceeding in iterative fashion (Börjesson, 2005). Börjesson (2006) has suggested guerrilla tactic employment for agile improvement practices in software organization. Abrahamsson and Salo (2007) proposed 'Iterative Improvement Process' (IIP) to improve the software developers' capability within individual agile project teams. It consisted of six steps: preparation, experience collection, planning of improvement actions, piloting of process enhancements, follow-up and validation, and storing of SPI results.

A well known quotation by Tom DeMarco "you cannot control what you cannot measure" suggests that merely implementation is not enough you need measurements to control any improvement initiative in addition. Abrahamsson (2000c) has presented five dimensions (project efficiency, impact on the process user, business success, direct operational success, process improvement fit) to measure SPI success. These dimensions help in defining metrics. Börjesson et al. (2006) listed four practical indicators for tracking and follow-up SPI. These indicators are: training participation, perceived acquired know-how, the tool use indicator, the steering group participation indicator. These indicators focus on competence build-up, employee capabilities, process adoption and management commitment.

In 2000s research efforts were made to study assimilation gap reported by Fichman and Kemerer (1999) and agile improvement practices have also caught great deal of attention.

2.3 SPI Success Factors

Case studies, experience reports and some articles published since 1992 till 2006 were studied in order to determine the reasons for failure of software community to implement SPI efforts.

Earlier studies were conducted to determine success factors (e.g. Niazi et al. 2006; Dybå, 2005; ElEmam et al., 2001; Stelzer & Mellis, 1998). But these studies have been conducted within special geographical areas like Niazi et al. (2006) conducted study in Australia and Dybå (2005) concentrated in Norway. Thus, we can not consider any one as background of this study due to influence of cultural aspects. We selected case studies and experience reports irrespective of any specific geographical origin.

We selected 28 case studies, experience reports and research articles in all (For more detail about selection criteria see section 4.2.1 and for the list of selected organization see Appendix A). After careful analysis of this literature we determined ten key success factors (For more detail of analysis technique see section 4.2.1).

Following success factors were determined that may influence any SPI effort.

Success Factor	**Frequency** (n=28)	**Ratio**
Process improvement sustainability	3	10%
Reviews	3	10%
Clear SPI goals	3	10%
Business objectives	5	18%
Training	6	21%
Communication and collaboration	6	21%
Planned initiatives	8	29%
Experienced staff	10	36%
SPI Team commitment	10	36%
Management commitment	14	50%

Table 2.2: List of success factors for SPI

The success factors are briefly described as follows.

Process improvement sustainability

SPI requires repeated and consistent efforts. It needs continuous investment of resources and sustainability to keep process improvement alive (Komi-Sirviö, 2004). SPI is usually not considered as a real work so process improvement practices are bypassed in case of any hindrance to meet goals of other projects (El-Emam & Briand, 1997). When deadlines are approaching or funding is insufficient then again SPI is sacrificed (Stelzer & Mellis, 1998). Rainer and Hall (2003) argued that in case of management turnover, enthusiasm and commitment for process improvement activities could not be sustained. So, process improvement sustainability is important for the success in SPI.

Reviews

Reviews at regular intervals are highly recommended to monitor progress and proceed in right direction. Dangle (2005) argued that review meetings provide an opportunity to talk about process improvement and make process improvement implementation easier. Rainer and Hall (2003) have also emphasized on reviews by saying that it provide an opportunity to share knowledge and expertise.

Clear SPI goals

Defining clear and realistic SPI goals is essential for the success of process improvement initiative (Stelzer & Mellis, 1998). Niazi et al. (2006) has stated that 25% of SPI case studies consider clear SPI goals crucial for the success in process improvement effort. Any process improvement initiative without concrete and clear goal will not be fruitful at the end.

Business objectives

The eventual goal of process improvement is to gain competitive edge and business supremacy (Weigers, 1998). Dybå (2005) has suggested aligning SPI goals with business goals and strategies. Stelzer and Mellis (1998) have argued that introducing process change as business practice will increase the probability of success. Thus, we need to design SPI initiatives addressing business goals rather than pursuing compliance with any process improvement model (Hara, 2000).

Training

It is necessary to acquire trained process improvement personnel to institutionalize change successfully. Salvaneschi (2006) argued that by improving skills of the people involved in SPI, it will become easy to achieve SPI. Dybå (2005) has reported exploitation and exploration as a success factors for process improvement efforts. Exploitation involves adopting and using existing knowledge and experiences whereas exploration refers to exploring new knowledge or innovation (Dybå, 2005). Usually staff possesses technical skills but unaware of processes and methodologies. So, while taking process improvement initiative, it is critical to determine the expertise of process improvement staff (Dangle, 2005).

Communication and collaboration

Software process improvement is threatened with resistance and fear. There is unknown fear of leaving well practiced routines and adopting new ideas (Stelzer and Mellis, 1998). Communication helps to resolve misunderstandings and overcomes resistance. Stelzer and Mellis (1998) concluded that communication and collaboration has been addressed as a success factor in 64 % of the ISO cases and in 74 % of the CMM cases. There is immense need of selling change to those who will be directly affected, through communication, education and help to adopt the change (Nichols & Connaughton, 2005).

Planned Initiatives

Well planned and dedicated improvement initiatives lead software process improvement effort to the road to success. It makes it easy to execute process improvement initiatives but less planned initiatives most probably end in failure. Börjesson (2004) has suggested for dedicated process improvement initiatives instead of generic ones and designing less time consuming initiatives. Process improvement initiative should focus on organizational needs instead of blindly pursuing one size fit for all. Stelzer and Mellis (1998) emphasize to prioritize improvement efforts on the need of urgency basis.

Experienced staff

Software process improvement needs soft skills more than technological expertise. While staffing SPI team, it is necessary to select experienced personnel (Mehner, 1998). Rainer and Hall (2003) have reported experienced staff as a success factor for SPI due to central role of people's expertise and experience in success of SPI. It is evident from SPI literature that any process improvement initiative started with non professional staff having no prior experience of process improvement effort resulted in chaos and failure (Hardgrave, 2005).

SPI team commitment

It has been acknowledged in SPI literature that commitment of individuals associated with process improvement team is critical for success **(**(Niazi et al., 2006; Stelzer & Mellis, 1998; Dybå, 2005; Salvaneschi et al., 2006**).** Staff commitment can be achieved through involving personnel who are going to use it later on and are supposed to be affected after change initiative (Hardgrave, 2005). Stelzer and Mellis (1999) argued that without the active participation of end-user of SPI effort, it will not be able to get its payoff and will be useless. So, it is suggested that change should not be imposed by external group; instead users should contribute their part to this effort. These people will be more enthusiastic and committed towards change process and it will increase the probability of success.

Management commitment

Management commitment is considered vital for the success of SPI. My analysis has reported that management commitment is the most occurring success factor in SPI literature as 50%. Software process improvement is an expensive deal and it needs a strong sponsorship. Any process improvement project without strong sponsorship and lack of leadership involvement may face crisis and becomes uneasy to continue (Dybå, 2005). Stelzer and Mellis (1999) have reported that management commitment and support is the most referenced factor, 84 % of ISO cases and 97% of the CMM cases considered it vital for success of SPI initiatives. Process improvement is a continuous effort unlike other projects. So, it demands strong management commitment for SPI more than any other project.

3. Management Commitment in SPI

3.1 Defining Management Commitment

It is important to understand what 'management commitment' is. In SPI literature two different statements exist regarding management commitment. Sometimes management commitment is referred to as allocation of resources like funding and staffing (Stelzer & Mellis, 1999). Sometimes it is defined in terms of motivating others and bringing passion and excitement (Senge, 1990). For this study, I define management commitment in terms of providing resources and active involvement in process improvement. Active involvement refers to monitoring SPI activities and developing personal interest in process improvement initiative that ultimately brings up energy, passion and excitement among employees.

Johansen and Mathiassen (1998) have suggested three dimensions for the active role of management in success of software process improvement effort. These dimensions are:

1) Insight in general SPI and more specifically keen interest in SPI activities within organizational context

2) Support SPI while steering change within organization and favor in the time of crisis.

3) Accept SPI and show it through actions, by providing sufficient resources in terms of time, budget and personnel.

Wise (1996) has articulated following actions for management to make SPI successful.

"

- Provide and sustain funding for SPI
- Providing and sustaining resources for SPI
- Creating and communicating rewards and recognition to encourage contribution to the SPI efforts.
- Establishing an infrastructure that motivates and prepares individuals to participate in the SPI effort.
- Providing continuous monitoring of the SPI activities
- Visibly demonstrating commitment to SPI

"

3.2 Role of Management Commitment in SPI

Certainly SPI literature is rife with statements acknowledging key importance of management commitment for success of SPI. On other hand; there exist some statements presenting some contradictory views about role of management commitment in SPI. Firstly, it is given that why management commitment has been considered vital for SPI success, then followed by presentation of contradictory views regarding role of management commitment in SPI.

Stelzer and Mellis (1998) argued that SPI requires a lot of resource investment in terms of time, money and effort. Moreover SPI modify current practices and change always comes up with resistance. So, procurement of all required resources and overcoming resistance towards change is not possible without management commitment. It has been further argued that sometimes management commits to process improvement without knowing the estimation of investment of resources to be made. Management does not provide sufficient time to cope with process improvement tasks. Consequently, middle mangers find it difficult to fulfill their commitments.

Saiedian and Chennupati (1999) argued that getting latest tools and technologies and possessing best technical people can not guarantee the quality improvement. In fact, it is only management that can ultimately lead to quality improvement. Management decides the initiative to be taken and later on directs SPI efforts. It is the management that provides funding and resources for successful implementation of SPI and furthermore disseminates process improvement goals across all organization levels.

Abrahmasson (2000a) stated that employees set their priorities according to the perception received from managers. If management is not diligently supporting SPI then it will give a negative impression to employees at other organizational levels.

Rainer and Hall (2001) argued that long term management commitment is necessary for SPI. It is not a one time effort that needs financial assistance for a specific time. If one manager has keen interest for process improvement in his organization and continuously striving in this regard then exile of such a manager might deteriorate all impact of SPI. Thus perseverance of management commitment is needed.

In spite of all emphatic views about critical importance of management commitment in SPI initiatives, there exist contrasting views as well.

Abrahamson (2000a) has reported the results of a study addressing a question “Is management commitment a necessity after all in Software Process Improvement?” It reports the results of 12 SPI initiatives and five interviews with SPI professionals in Finland. It is argued that if we confine the term management commitment to allocation of necessary resources then surely we have need of it. But, if we consider that manager should bring energy, passion and excitement then its answer is NO. Managers do not have to play any vital role more than funding, staffing and providing sufficient time for SPI efforts. Furthermore it is argued that process improvement champions are more important than committed managers.

Dybå (2005) discussed that despite of agreed belief about critical importance of management commitment results shows that it is not essential to have it in all cases of SPI. This analysis is based on the quantitative survey of 120 organizations in Norway. Furthermore, some explanations are made to understand this conflict. One reason has been cited that there is no common understanding of management commitment. Another reason explains employment rules in Scandinavian region that has reduced power difference.

3.3 Prior Research

Previous research efforts about role of management commitment in SPI are discussed here. Though all studies are not solely dedicated to management commitment and partially explore some aspects of management commitment.

Baddoo and Hall (2002) conducted a study to determine SPI motivators across developers, project managers and senior managers in 13 UK's software companies. The SPI motivators reported by senior managers were: career prospects, cost beneficial, feedback, justifiable benefits, maintainable processes, meeting targets, process ownership, resources, reward schemes, taller hierarchy, task forces, and visible success. Out of these above listed motivators, some were reported for developers. These are: maintainable processes, process ownership, reward schemes, feedback, career prospects, sale ability, and taller hierarchy. Thus, we end up here with a set of motivators for managers: cost beneficial, justifiable benefits, meeting targets, resources, and task forces.

Baddoo and Hall (2003) reported SPI de-motivators across developers, project managers and senior managers as a part of the study conducted with senior managers (Baddoo & Hall2002). The SPI de-motivators reported by senior managers were: lack of resources, time pressure, inertia, lack of overall support, bad experience, lack of SPI management skills, budget constraints, commercial pressures, inexperienced staff, inadequate communication, cumbersome process, lack of evidence of direct benefits, organizational changes, and personality clashes.

We can not state certainly whether management is committed or not without having reliable measurements. Börjesson (2006) has reported four indicators for SPI success. Steering group participation indicator has been suggested to measure management commitment. The steering group participation chart is comprised of the data about presence and absence of steering committee members. The statistics provided by this chart provides measures that how managers spend time on discussions about SPI. This indicator is all about participation in steering group meetings.

Abrahamsson (1999) introduced an instrument to measure the level of commitment. This instrument is behavior-based commitment questionnaire. Moreover, this instrument is supported by a framework of the interpretation of the results. This questionnaire presents nine behavioral categories, i.e., open communication, collaboration, taking responsibility, maintaining a shared vision, solving problems effectively, respect or support, facilitating interactions, inquiring, and experimenting. The questions in these categories could be modified and scaled based on the context of implementation. Through behavior-based commitment models or framework,

change agent could determine that on what specific behaviors needs more concentration and any change in behavior is itself indicator of commitment, it could be positive or negative.

Abrahamsson (2000b) presented a theoretical framework of management commitment process. This framework explains how management commitment could be developed based on psychological, sociological and organizational behavior literature.

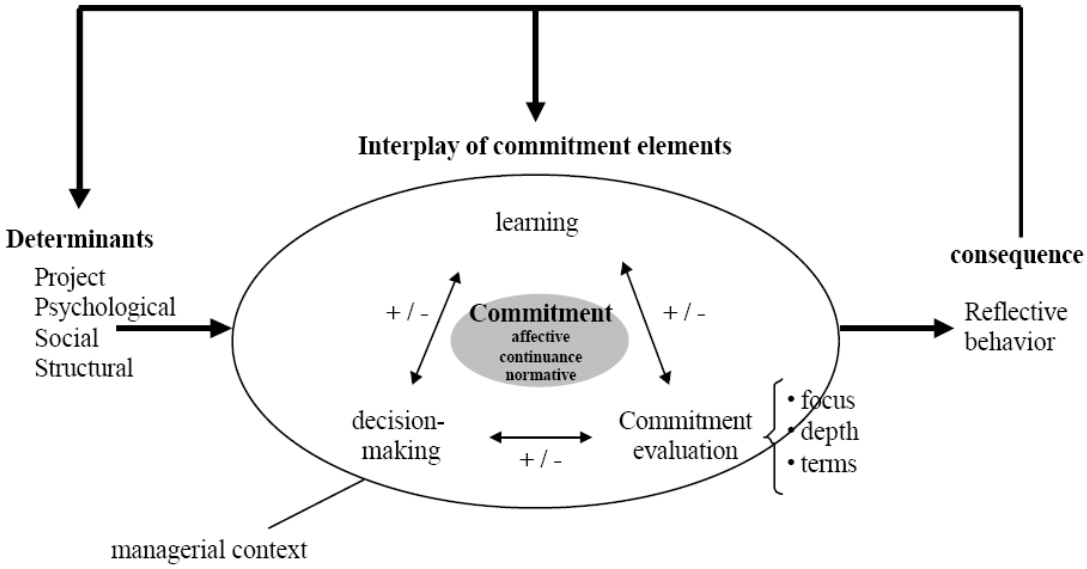

Figure 3.1: Managerial Commitment Process (Abrahamsson2000b)

It considers four determinants (project, psychological, social and structural) as input to managerial context. This managerial context exhibits three forms of commitment (affective, continuance and normative). There are three inter-dependent factors (learning, decision making and commitment evaluation) that gradually increase or decrease. Reflective behavior appears as output of the interplay of all these commitment elements embodied in the managerial context. This framework helps us to understand management commitment development as a psychological and sociological process.

By summing up, the previous research reports SPI motivators and de-motivators in view of senior management. There are few studies suggesting the ways to measure management commitment. But still curiosity remains about SPI practitioners dealing with this issue. SPI practitioner (e.g. process engineer, change agent) is considered responsible to lead process improvement effort to success by coping with any trap or hindrance. Thus it is also the responsibility of SPI practitioner to make management commitment happen in SPI. The extant SPI literature lacks any research effort that has investigated motivators, de-motivators and indicators of management commitment in view of SPI practitioner.

4. Method

This section describes the methodology employed for this study. At first, research approach is mentioned that is followed by research process.

4.1 Research Approach

The research in this thesis has been conducted in two phases. At first, exploratory research was conducted that was followed by empirical investigation. The research approach is described as follows.

4.1.1 Exploratory Research

Firstly, the success factors for SPI were determined by conducting exploratory research.

"When some thing is ambiguous and not clear then exploratory research is made to understand the ground reality" (Stebbins, 2001).

In this case, there were few prior studies about success factors for SPI. Since these studies were conducted in different geographical contexts, so the presentation of success factors was not consistent amongst them. Thus, we could not consider any one of them as basis for this study. Consequently, we decided to conduct exploratory research to determine success factors for SPI based on case studies and experience reports; irrespective of any geographical context.

4.1.2 Grounded Theory

In the second phase of the research, 'making management commitment happen in SPI' was investigated through grounded theory research approach. In recent years, grounded theory has emerged as a popular qualitative research method in software engineering research (e.g.,). Grounded theory approach implies 'continuous interplay between data collection and analysis' (Coleman, 2007). Grounded theory seeks to get information that is grounded in collected data instead of existing theory (Gasson, 2004). Furthermore, it provides a theoretical framework by breaking down data into distinct themes, concepts and categories and then linking these categories to formulate a theory (Coleman, 2007).

4.2 Research Process

The research process was carried out in two phases. The first phase of research consisted of literature study while the second phase constituted empirical study. Detailed research process of each phase is given below.

4.2.1 Literature Study

This section reports the selection criteria of case studies, experience reports and research articles. It also reports the method of data analysis.

Data Collection

Twenty-eight case studies, experience reports and research articles were analyzed. Classification of data into three categories was the idea came out of inspiration from Niazi et al. (2006). Firstly, case studies clearly describing lessons learned from SPI efforts were analyzed. It was fairly easy to determine success factors from lessons learned. Secondly, some case studies elaborating the details of process improvement effort were considered. Nothing was found like lessons learned in these case studies. It was felt to go through these articles carefully and analyze the success factors or barriers encountered during the process improvement journey. There was a third category of articles describing success factors identified through an empirical study. Success factors were listed in these articles. Thus, it was also quite easier way to get success factors from these articles.

Data Analysis

To analyze the data, 'content analysis' was employed. Content analysis is used to determine quantitative results in terms of frequency analysis from qualitative data (Niazi et al., 2006). The ambition was to determine success factors affecting software process improvement effort and to find their frequency of occurrence thereafter. Firstly, success factors were identified by careful analysis of qualitative data in the form of published reports and articles. Secondly, the frequency of the occurrence of each success factor in literature was determined. A prioritized list of success factors was concluded as a result (detail of success factors is provided in section 2.3).

4.2.2 Empirical Study

Literature study remarkably indicated that management commitment was the most frequently cited success factor with 50% ratio in 28 publications. It facilitated and specified qualitative study with SPI practitioners to collect their views and experiences about the role of management commitment in SPI. Data collection procedure and analysis of data is described as follows.

Data Collection

Selection of Respondents

SPI practitioners in five different countries were contacted. Within Sweden, SPI practitioners from Ericsson and Volvo IT were contacted. A consultant, experienced in working for SPI in many Swedish companies was also contacted. Moreover, three companies in Pakistan; following CMM as maturity model were approached. However, in rest of countries it appeared to be very difficult to figure out appropriate person. In this regard we used SPINs (Software and Systems Process Improvement Networks). SPINs has been initiated by SEI (Software Engineering Institute) to allow software and systems process improvement community in a geographical area to communicate frequently (SPIN, 2007). We used SPINs to contact SPI practitioners in USA, France, and Canada.

The response rate was quite astonishing within Sweden and Pakistan. Out of six requests made in Sweden, five responses were positive. But only one request remained un-responded and three acquired quite positive replies in Pakistan. Thirty requests were sent to SPINs (SPIN, 2007). Eight of these requests were responded positively, two were turned down and rest of the requests was not responded. The following table describes the number of respondents from each country and the medium of communication (i.e., face-to-face interview, telephonic interview and questionnaire).

Country	Face-to-face interview	Telephonic interview	Questionnaire	Total respondents
Sweden	5			5
Pakistan		2	1	3
USA		1	5	6
Canada			1	1
France			1	1
Total	5	3	8	16

Table 4.1: Respondents from each country and medium of communication

Structure of Questionnaire

Questionnaire (see Appendix B) was divided into two parts. First part was regarding demographics, seeking brief introduction of interviewee and SPI practices in the organization. Second part was about the role of management commitment in context of SPI.

Demographics

There were sixteen respondents in all. The following table describes experience of respondents in software industry and software process improvement domain.

Experience Range (years)	Software Industry	SPI
21+	3 (18%)	0
16-20	5 (32%)	0
11-15	4 (25%)	1 (6.25%)
6-10	2 (12.5%)	13 (81.25%)
2-5	2 (12.5%)	2 (12.5%)

Table 4.2: Respondents experience demographics

The demographic data shows that 81% of respondents have experience ranging from 6-10 years. It gives confidence that data has been gathered data from experienced practitioners in SPI domain.

Interviews

Eight qualitative interviews were conducted. Five of these were face-to-face whereas three were telephonic. The participation request was disseminated through e-mail. After participation confirmation and scheduling the interview, questionnaire was sent well before the interview. So, respondent have not to brainstorm during interview session. Face-to-face interview normally consisted of forty minutes. Interview session was started by presenting the motivation of the study. Interview was focused on the questions given in the questionnaire. Hence, it could be completed within the scheduled time. Notes were made during interview. At the end of each interview session all the discussion was documented. In case of ambiguity or further clarification; interviewee was contacted as interview follow-up process. Same sequence of steps was adopted in telephonic interview except that the time duration was reduced to thirty minutes.

Questionnaire

Since the primary method of this study was conducting interviews. But, later on we adopted questionnaire as an alternative. One reason to go for this option was the choice of some respondents and secondly time difference with interviewee's geographical location also mattered a lot. Questionnaire was disseminated through e-mail and in some cases web link was provided to access online questionnaire. The questionnaire delivered through e-mail and available online were consisted of same set of questions.

Data Analysis

Grounded theory analysis procedure was employed for data analysis. It is described as follows.

Theoretical Sampling: It refers to collecting and analyzing data and concurrently developing theory (Coleman, 2007). Initially there is no clear idea about the future dimensions of theory. Data collection is initiated based on the initial sampling. While the data collection and analysis is going on then some new categories are emerged requiring more focus (Coleman, 2007). In order to cope with these emergent categories, new questions are added. This process continues unless no more categories emerge (Coleman, 2007).
In this study, one question was added about the reasons of lack of management commitment.

Open Coding: It is referred to analyzing data line-by-line from interview transcripts. Codes are allocated to text. This coding process is done by breaking down data into distinct concepts (Coleman, 2007). Data is broken down, compared, and conceptualized (Strauss & Corbin, 1998). In this case, data was collected from sixteen respondents through interviews and e-mail. After reading transcripts of each interview or questionnaire, distinct concepts in the transcript were highlighted. Then similar concepts and themes were classified with the same name. The out come of open coding was classification of data into twenty categories.

Axial Coding: In the open coding phase all data is split up into basic categories (Coleman, 2007). Axial coding puts these data back together and defines categories and its sub-categories (Strauss & Corbin, 1998). The term axial refers "coding occurs around the axis of a category linking categories to subcategories at the level of properties and dimensions" (Coleman, 2007). In this study, there were different concepts that could be grouped into one category. Thus, by making connections among twenty categories and relating those ended up with eight categories (invisible ROI, parallel activities, wrong motivation, un-awareness of SPI, business orientation, awareness of SPI, qualitative indicators, and quantitative indicators).

Selective Coding: In this phase core categories are selected by validating relationship among categories and doing further refinement (Strauss & Corbin, 1998). Categories are just description of data, so by combining them and relating to a core category develop them as a theory (Coleman, 2007). On the basis of our themes and categories identified in open coding and axial coding phases respectively. It was further refined into theory by interrelating eight categories to three core categories (motivators, de-motivators and indicators).

5. Results

The research effort was three folded to explore the role of management commitment in SPI. First aspect was to investigate the reasons that lead to lack of management commitment. Here it is addressed as de-motivators of management commitment. Second aspect was to determine the ways to win management commitment. It is presented here as motivators of management commitment. Lastly, indicators of management commitment are reported.

5.1 De-motivators of Management Commitment

There are some de-motivators that cause lack in management commitment. In the presence of these de-motivators; management commitment will be at stake. We identified four de-motivators, i.e., return of investment, parallel activities, un-awareness of SPI, and wrong motivation.

1.1.1 Return of Investment (ROI)

ROI refers to pay offs of SPI effort. SPI is initiated to improve current practices. New processes are institutionalized to overcome existing problems and to achieve desired results. SPI is a costly effort in terms of finance, time, and resource investment. Managers seem to be eager to see some visible results in return of this investment. When they can not see results then consequently they loose their interest in process improvement. A process engineer in a CMM Level-2 organization elaborated:

> *"For process improvement initiative, we need resources, time and funding. When management invests so much then in return expects some thing. (…) In the beginning you can win management commitment by telling some fabulous stories of process improvement. But if you do not show any ROI of process improvement, then ultimately they will lose interest".*

According to empirical data, ROI could be defined in terms of cost reduction, delivery time, quality of the product, less dependency on resources. Furthermore, it refers to fixed problems those have troubled in the past. One representative comment in this regard by an SPI Manager was:

> *"Show ROI, in terms of improvements and productivity. Reduce number of defects, reduce dependency on resources. You may not need heroic efforts if you have strong processes".*

Commitment to SPI significantly lowers for the management, in case of absence of any visible result. When management could not see any ROI then there is no reason for them to commit on SPI.

1.1.2 Parallel Activities

Software organizations concurrently work on many activities like software development and maintenance. These projects are main source of income and SPI is actually started to support and assist in the success of these projects. A SPI Manager in a CMM Level-2 organization illustrated:

"In smaller companies they invest a lot of time in maintenance. They are always in haste to fix problems and deliver it to customer. In this situation they ignore processes. When situation is like this, that sometime you follow processes and sometime do not. Then all things are messed up and at the end and process improvement results are not visible."

SPI can not be placed appropriately by the management as far as the management fails to acknowledge its importance. An illustrative comment by an SPI Manager in this regard was:

"SPI is seen as a bottom priority, to be done only in 'spare time' if no other 'revenue enhancing' comes along."

SPI will always be challenged by parallel activities. It is not easy for management to opt for SPI at the loss of other projects. Whenever there is a decisive situation to make choice of one between two, then SPI will be neglected unless the importance of SPI is realized.

1.1.3 Un-awareness of SPI

Un-awareness of SPI refers to lack of knowledge of SPI. Managers are usually not aware of SPI, the way change steers in the organization, challenges faced, and time span for obtaining result. They are usually fascinated by the glories and glitter of SPI without knowing it in actual. SPI is started with a lot of enthusiasm, but this all ends up at discouragement and consequently giving up the effort. A process manager illustrated:

"Usually management has no interest in SPI by them; these were some external factors that lead them to initiate process improvement. So when they observe resistance from employees and they don't value SPI then their interest is reduced."

Lack of involvement in SPI activities is another aspect of un-awareness of SPI.
When management could not get involved or monitor SPI activities then it can not get the true picture of the things happening inside. A SPI Manager at CMM Level-3 organization commented:

"As far as management monitoring is concerned, it has become a challenge for the success of SPI programs. Many SPI initiatives in software industry have proved that in the organizations where higher management itself has not monitored the progress and resolved the issues, SPI programs have been delayed or completely failed. On the other hand, in organizations, where higher management involved in status review meeting and paid a close attention to resolve the issues and dependencies, are very successful in their SPI programs."

From our empirical data it was evident that resistance towards change is increased when management does not get involved actively in monitoring activities of SPI. Majority of our respondents advocated the active involvement of management in monitoring SPI. But one of them opposed it by reasoning that too much management involvement will kill SPI.

1.1.4 Wrong Motivation

Real SPI can not be achieved with the wrong motivation even if it seems to seek SPI. The process maturity is the actual goal set by the SPI instead of seeking a label of process maturity. A quality manager commented:

> *"Initially management commitment is a marketing game to gain certification. They want to achieve benefit for marketing of the accreditations perspective. Management commitment comes down by knowing that heavy work is involved and the certification will not come for several years. It is really hard to find managers who want SPI to improve quality."*

Process improvement is a continuous journey and pursuit of perfection never ends. Plenty of recourse investment is required for the purpose. Moreover, it needs durability of management sponsorship and commitment. Thus any process improvement initiative having wrong motivation can not sustain in the long run. An elaborative comment in this regard was:

> *"Management commitment comes down by knowing that heavy work is involved and the certification will not come for several years."*

It is evident from empirical data that any process improvement effort based on wrong motivation will suffer inconsideration and lack of commitment on behalf of management.

5.2 Motivators of Management Commitment

Business orientation and awareness of SPI were identified two motivators to inspire managers for SPI.

Business Orientation

Business orientation refers to tailoring process improvement activities according to business needs. One consultant of SPI commented:

> *"Managers are hired to make business; they are not hired for SPI. So show them what and how SPI will add to their business success. SPI is just a tool to make business and improve business. (…)SPI is a long term run, so you need to define objectives that have value for company and show results periodically."*

Managers are required to be elaborated by the significance of SPI on the business. We need to convey managers the impact of SPI on business. How SPI will help to increase financial savings and market share. A significant view in this regard by a SPI manager was:

> *"Motivate managers by showing financial returns. Convince them through facts and figures. For example, by telling that today we spend xxx $ on fixing post*

delivery defects and more than that there is possibility of losing customer as well. Then show them lose in term of dollars."

Another aspect of aligning SPI activities with business is to understand organizational needs. Blindly pursuing any process improvement framework without knowing your organizational needs can prove fatal for the process improvement. Process improvement initiatives must be designed based on organizational needs. A representative comment by an SPI Manager in a CMM Level-2 organization was:

"Do not pursue blindly any process improvement framework (…) understand your organizational needs. Whether they are struggling for survival or developed a mature business. Understand the business goals, resource limitations and problems. Design SPI program inline with company objectives."

The synchronization and harmony between SPI practices and organizational needs will definitely reveal the factual importance of SPI to the management regarding organizational development.

Awareness of SPI

Awareness of SPI refers to the knowledge of process improvement. It is important for management to have knowledge of SPI for setting realistic expectations. A significant remark by an SPI manager in this regard was:

"Management education as to how to do a process improvement program, what to expect in benefits, effort, and the time involved. (…) There is too much noise in the process to accurately say that x process improvement has resulted in y benefits. I would like to see SPI create some standard metrics such as: a) was the change adopted by the organization? b) Did the change obtain its stated objectives c) Are the practitioners using the new practices 6 months after rollout completed?(…)management should acknowledge that their will be failures and setbacks, but not punish the pioneers."

Another aspect of awareness of SPI is to communicate management that what is happening inside. One representative comment in this regard by an SPI consultant was:

"As an SPI agent I recommend to have bi-weekly meetings with top management, where you can discuss your plans, programs and dilemmas. These meetings should be only between change agent and managers, where you can freely discuss about the response of individuals towards process improvement. (...)Some people are simply negative and don't want to adopt the change for personal reasons. They take a lot of time to institutionalize the change and ultimately it becomes expensive."

A remarkable change in the level of interest of management will definitely be observed; if the management start acquiring knowledge of SPI in general and have insight about SPI activities inside the organization in particular.

5.3 Indicators of Management Commitment

There are some indicators to measure management commitment towards SPI. These are clarified as qualitative and quantitative indicators.

Qualitative Indicators

Qualitative indicators are referred to as behavioral attributes. Managers' behavior and attitude towards SPI show their commitment. It could be perceived through discussions, what they speak about SPI and their attitude towards SPI activities.

An illustrative quote by a Process Engineer was:

> *"Management commitment can easily be measured by their action. Actions speak how much they are committed towards process improvement. Are they allowing people to take trainings and allocating time for these activities. Management commitment can be perceived from their behavior as well. If SPI team introduced use case specification, but managers ask for SRS specification then it shows their negative intent towards process improvement."*

Actions are another indicator of management commitment. SPI is all about change. In order to institutionalize change, we need to change the culture of the organization on the whole. This cultural change can not be achieved without full support of management. A desire for change is not enough, it needs much more from management. A SPI manager commented:

> *"The *problem* is that too many times Lip Service is given to quality/process improvement programs and yet not enough budget, time, tools, or other realistic expectations and support are provided."*

Qualitative indicators give a quick measure of management commitment. The level of manager's commitment could be easily perceived from discussions and actions.

Quantitative Indicators

Quantitative indicators refer to quantitatively measurement of management commitment. One quantitative indicator of commitment is participation in the steering committee or SEPG (Software Engineering Process Group) meetings. An illustrative comment in this regard by an SPI Manager was:

> *"We use a chart that indicates the presence or absence of process improvement stakeholders. Three different colors are used to represent their status in the meeting. If one does not come then we just assign a red block. We use green for presence and if some one comes late or leave earlier then we assign yellow. For this purpose we do not use names instead show some other identifiers. After some time, it gives us good quantitative measures about someone's commitment to software process improvement. "*

Issue resolution chart is another way to measure management commitment quantitatively. It shows that how many issues are fixed and how urgently; on the behalf of management. One SPI Manager from a CMM Level-3 organization elaborated:

"We use 'issue escalation process'. By using this process, issues are identified in internal audit. Then responsibility is assigned. There could be some issues related to management e.g. training, human resource and technological. It is analyzed by comparison of resolved problems and pending problems on behalf of management that how much committed they are."

Quantitative indicators provide management commitment on a scale. It is not quickly visible. In order to get quantitative measures, certain time is needed.

6. Discussion

The study aimed to determine motivators, de-motivators and indicators of management commitment. A comparison is provided between our findings and extant research and its implications.

6.1 Role of Management Commitment in SPI

There are two schools of thought regarding role of management commitment in SPI. There are several case studies and experience reports acknowledging key role of management commitment and arguing why it is critical to have management commitment in making SPI happen (Basili et al., 1997; Curtis, 2000; Dangle, 2005; Ogasawara et al., 2006; Hara, 2006; Hardgrave, 2005; Salvaneschi et al., 2006). But on contrary, there are also some studies presenting a different perspective and denying the role of management commitment for the success of process improvement effort (Abrahamsson, 2000a; Dybå, 2005). These divergent claims make one curious to seek reality.

Through our empirical investigation, we argue that this question can be answered globally, neither in YES nor in NO. In fact, there are some factors to be considered while answering this question.

In accordance with the observations of Dybå (2005), we consider that cultural impact is one of the important factors regarding the role of management commitment in SPI. The role and influence of management change in different cultures. Management might not have too much influence on lower organizational levels in a culture having less power difference. In this case a strong rationale for any change initiative is needed to get people committed. Management can not simply impose their decisions. We can cite example of Scandinavian countries having less power difference that suggests higher importance of employee participation (Dybå, 2005). In this scenario process improvement initiative could be succeeded without management commitment. Though, it will be costly, time consuming and some time leading to un-clear decisions. In other scenario with big power difference; management has immense influence for the success of SPI efforts. In this situation, commitment of employees has strong adherence to the management commitment. Any inconsideration from management may lead SPI project to failure. We can cite example of US with bigger power difference than Scandinavian countries (Dybå, 2005).

Secondly, our findings suggest that public and private organizations also have diverse needs. A process improvement initiative in a private organization might have less likelihood of success without management commitment. On contrary in a public organization, management commitment may not have too much impact.

6.2 De-motivators, Motivators, and Indicators

De-motivators

Baddoo and Hall (2003) have reported some de-motivators of senior management as a result of a study conducted with senior managers in thirteen UK software companies. Here we compare these de-motivators with our findings. We discuss similarities and dissimilarities between the two set of de-motivators reported by senior mangers and our findings from SPI practitioners as follows. In our study, one significant aspect is that we have not used same labels for de-motivators as used by Baddoo and Hall (2003), but in some cases one label might be representing similar concept used with a different name in other study. In comparative analysis, we will refer de-motivators reported by Baddoo and Hall (2003) as de-motivators reported by senior managers and our findings as de-motivators reported by SPI practitioners.

Lack of resources, time pressure, bad experience, lack of SPI management skills, budget constraints, commercial pressures, inexperienced staff, inadequate communication, and lack of evidence of direct benefits were amongst de-motivators as described by senior managers. Whereas the de-motivators reported by SPI practitioners were: parallel activities, invisible ROI, wrong motivation, and un-awareness of SPI.

There are some similar factors among the two groups. Two de-motivators reported by senior managers ‘time pressure’ and ‘commercial pressure’ present similar insight as that of de-motivator ‘parallel activities’ reported by SPI practitioners. Similarly ‘lack of evidence of direct benefits’ by senior managers is represented by ‘invisible ROI’ by SPI practitioners. ‘Inadequate communication’ reported by senior managers is partial part of ‘un-awareness of SPI’ reported by SPI practitioners. ‘Lack of resources’ and budget constraints reported by senior managers’ show that SPI community has not realized it as a de-motivator.

From the comparative analysis of de-motivators; it has become obvious that SPI practitioners have better understanding of factors which can de-motivate management. But still they have overlooked ‘lack of resources’ and ‘bad experience’ as de-motivator of management. SPI practitioners need to acknowledge that scarcity of resources can also prevent managers to actively support SPI activities. Another possible reason for de-motivation could be ‘bad experience’ of any past SPI effort. There are two other de-motivators that have not been considered by senior managers. These are: wrong motivation and un-awareness of SPI that refers to lack of overall understanding of SPI.

Motivators

Motivators reported by Baddoo and Hall (2002) for senior management as a result of study conducted with senior managers in thirteen UK's software companies are discussed here in a comparison with our findings with the same background described in the section 6.2.

The motivators reported by senior managers were: cost beneficial, justifiable benefits, meeting targets and resources. On the other hand motivators reported by SPI practitioners are: business orientation and awareness of SPI.

The two motivators reported by managers: cost beneficial and justifiable benefits are directly related with 'business orientation' reported by SPI managers. By alignment of SPI objectives and goals with organizational and business needs will ultimately be cost beneficial and having justified benefits. By resolution of problems that have caused hindrance in the past to achieve business goals e.g. missing deadlines or cost overrun. Then addressing these organizational problems or business needs as SPI goals will help to achieve these goals as well. One motivator reported by managers 'meeting targets' has not been considered by SPI practitioners.

Meeting targets as a motivator reported by senior managers suggests that SPI practitioners should set realistic targets that could be easily achieved within settled timeframe. Another motivator reported by SPI practitioners is 'awareness of SPI' that has not been reported by Managers.

Indicators

Qualitative indicators are referred to behavioral measures. Our findings suggest that behavioral measures by SPI practitioners are just confined to perception and there is lack of proper measurement of different behavioral categories. It is not easy to draw a line between committed and non-committed managers or simply we can't say that one is committed or not (Abrahamsson, 1999). SPI practitioners need to look at behavioral categories level so that they can point out right area to be focused. Abrahmasson (1999) has proposed a questionnaire to study different categories of behavior. Hence to study behavior at categorical level is needed. It will give more concrete and exact measure of different behavioral categories.

6.3 Implications

This study has implications for both theory and practice. The study elaborates the need of studying SPI in global context. If we had conducted our research in Scandinavian context; then our results would have been different; simply denying the critical role of management commitment in SPI. Hence our study adds to existing body of knowledge with evidence of our findings that SPI should be studied in global context rather than specific context. It will bring up consistent results having no influence of cultural aspects. Our findings can help SPI practitioners in designing improvement initiatives that will render enhancement in management commitment.

7. Conclusion

This study investigates the problem of making management commitment happen in SPI. In particular, this study focused on motivators, de-motivators and indicators of management commitment. Our findings suggest that four de-motivators - (1) invisible ROI, (2) parallel activities, (3) wrong motivation, and (4) un-awareness of SPI – lead to lack of management commitment. Two motivators – (1) business orientation and (2) awareness of SPI- can help to inspire managers and make them committed to SPI. It is hard to determine the level of management commitment without proper measurement. Two categories of indicators – (1) quantitative and (2) qualitative – can help to measure management commitment. Furthermore, this study implies that role of management commitment in the success of SPI varies with the changing cultures and organizational setups. The possible future work is development of management commitment development model. The basic idea is distribution of motivators, de-motivators and indicators of management commitment along with phases of IDEAL model.

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Appendix

A: List of Organizations

Organization	References
NASA	Basili et al. 1997
Advanced Information Services Inc.	Ferguson et al. 1999
Motorola	Daskalantonakis1992, Daskalantonakis1994
Philips	Rooijmans and Aerts 1996
Tata Consulting Services	Curtis2000
DataStream Content Solutions	Dangle2005
Toshiba	Ogasawara et al. 2006
NewWorld Commerce	Hara 2006
Motorola Cork	Hara 2006
Large Spanish Company*	Guzm´an et al. 2006
AB Alna	
AAC	Hardgrave2005
Silicon and Software Systems	Hara 2006
Mediamarket (Media-Saturn Holding GmbH)	Salvaneschi et al. 2006
Allied Irish Bank	Hara 2006
Brazil and Finland Small Companies	Wangenheim et al.2006
IBM	Nichols and Connaughton 2005
SEI	Goldenson and Herbsleb 1995, Goldenson and Herbsleb 1996
Raytheon	Dion 1992
Hughes	Humphrey et al. 1991
Corning Incorporated	Johnson 1994
Siemens	Mehner et al. 1998
Telecordia	Pitterman 2000

* Its name is anonymous.

B: Survey Questions

Q1: Your experience in software industry (Years)

Q2: Your experience in software process improvement domain (Years)

Q3: Please specify your organization's current practices of process improvement effort and its level (if applicable).

Q4: What are the three important success factors for process improvement effort, in your view?

Q5: What are your views about management commitment? How you value it for the success of process improvement initiatives?

Q6: What are the factors that can lead to lack of management commitment in process improvement effort?

Q7: What kind of problems you usually face related to "management commitment"?

Q8: How often do you monitor management commitment and how you do that?

Q9: How do you measure 'management commitment' in your organization?

Q9: How do you audit 'management commitment', internally?

Q10: As a member of SPI community, what do you suggest, how we can make management committed?