The End of the Line: Project Management Challenges in Small Software Shops in Pakistan

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Abstract. Most software development companies are very small with only 1-10 employees. In developing countries such companies play an important role both locally and as providers of software and services to customers in other parts of the world. Understanding and improving their project management (PM) practices are, therefore, important not only in the local context, but also in the context of globalized software development. This paper explores actual PM practices in Pakistani Small Software development Shops (SSDS). We find PM challenges in addition to challenges reported by software engineering literature, and we have described the implications of those challenges on quality and productivity of Pakistani SSDSs. We also find that some Pakistani SSDS practices are similar to what is reported from SSDSs in other parts of the world, but other practices are related to the companies' position in the global software development chain.

Keywords: Project management, PM tools, small software shops, freelance portals, PM issues and challenges.

1 Introduction

Small software companies play a significant role in many of the world's economies [2, 1, 10]. In Europe, around 85% of software companies have 1 to 10 employees. [4] These software companies contribute 93% of all IT businesses in Europe and 66% of total employment in the software industry [3, 4]. A survey conducted in Denmark finds that around 89% of IT companies have less than 10 employees. According to a similar survey conducted in the US in 2005, around 80% of companies in the areas of software publishing and customer computer programming services have less than 10 employees [5]. In India; small IT companies represent up to 85% of all software organizations [1]. We have no actual figure from Pakistan, but we assume that similar numbers apply to the Pakistani software sector, since India and Pakistan have similar culture and business styles.

Organizational studies often bundle small and medium sized companies (SMEs) into one category, but the characteristics and limitations of SSDSs differentiate them from medium sized software companies. [1] SSDSs have limited financial and skilled human resources compared to larger software companies. The competition is tough, their software development process is primarily driven by time to market, high

flexibility, high risk orientation, unstructured planning, informal managerial process, and they have limited learning and knowledge absorption capacity [6, 7,1] Small companies in developing countries face further challenges i.e. lack of finance, low human resource and technological capabilities, poor project management competences, little access to skilled manpower, deficiencies in marketing strategies, low efforts on R&D and lack of innovative technology[12]. In addition to these challenges; small to medium sized enterprises (SMEs) in developing countries like India and Pakistan face system specific problems i.e. lack of corporate governance structure in the firm, corruption, barriers to trade, and bureaucratic, legal and regulatory obstacles [12]. Small software companies in developing and transitional economies may have limited access to capital due to deficiencies in their banking system or harsh collateral requirements [16].

There is remarkably little research into software engineering (SE) practices in SSDSs in spite of the large number of companies, their economic impact, and their unique characteristics [5, 4, 2, 20, 1]. There are even fewer studies of SSDSs in developing or transitional economies although such companies play an increasingly role in the global software production lifecycle, as software suppliers to companies in other parts of the world.

The purpose of this exploratory study is to study key issues and actual PM practices in SSDSs in developing countries like Pakistan. Therefore we will explore two research questions: *what are actual project management practices in SSDSs in Pakistan? And what are the key challenges facing by SSDSs during their project management process?* It is part of larger research project that will compare SE practices in developing and established economies.

The paper is structured in six main sections: Related Work, research method results from the interview study, discussion and conclusion.

2 Related Work

There is remarkably little research into the challenges and practices of SSDSs in general and even less about SSDSs in developing countries in particular. This claim has also been supported by many studies i.e. [5,4, 2 ,20, 1]. Research into SE practices in SSDSs includes studies of software process assessment and improvement [4; 20, 8, 19, 18 10], realization of agile methodology in SSDS [5], configuration management [20], reuse, and knowledge management [8, 1]. Many SPI initiatives in SMEs have been reported i.e. CMM, CMMI, ISO/IEC 15504:2004, SPICE (ISO/IEC 15504:1998), ISO/IEC 12207:2004 and ISO 9001:2000, but the literature particularly discussing SE methods in SSDSs is almost nonexistent [1, 27]. SE literature reports that CMM, ISO 15504, and IDEAL are the most frequently used software process improvement (SPI) frameworks in medium size companies but not a single publication has reported if these three models have been adopted by SSDSs [3, 8, 2]. The perception among SSDSs, however is that these SPI standards and models are very difficult to implement, time consuming, and expensive to apply [22, 25].

An efficient management process is very important for the success of SE projects. [13] The management community in general and project management (PM)

community in particular have, however, proposed little guidance for SMEs to manage their projects and PM Institute has specified that further research is required to streamline PM Body of Knowledge (PMBoK) for SMEs [14]

To our best knowledge, only a couple of publications from Pakistan concern SPI in SMEs but there is not even a single explorative study published from Pakistani SMEs or SSDSs. SSDSs in developing countries do, however, play an important role both locally and as providers of software and services to customers (other software companies or the actual buyer of the product or service) in other parts of the world. [16] Understanding and improving their practices and challenges is, therefore, important not only in the local context, but also in the context of globalized software development. This study, therefore, familiar with actual PM practice in SSDSs, my attention has been caught to focus on exploring the key issues and actual PM practices in SSDSs in developing countries like Pakistan.

3 Research Design

This study comprises of SSDSs whose primary business is software development and they are working as independent software companies have 1-10 employees. We collected data from one of the developing countries i.e. Pakistan. We selected Pakistan for data collection because one the authors of the study has easy access to Pakistan, familiarity with culture and local languages, and he had practical access to SSDSs. The qualitative approach is consistent with the nature of current study because, first, it is a subjective approach which focuses on finding questions in term of "what", "why" and "how" and secondly, it helps in understanding the objects in their environment in which they operate [11].

In addition to investigating the relevant literature, this study strongly needs to look into organizations and to understand actual PM practices in SSDSs. For this purpose we have used Grounded Theory (GT) methodology to determine what is happening in actual PM practices in SSDSs. This process involves development of codes associated with collected data, code categories, inter-relationship of code categories and their sub categories, and integration and refinement of theory. [17]

We have interviewed seven SSDSs in Pakistan, here anonymously labeled with the letters A through G; refer to table 1 for further information. From each SSDS, two relevant employees were requested to participate i.e. a project manager and a senior software developer. From Software Shop A and B we were able to access two interviewees i.e. project manager and senior developer, but from the rest of the SSDSs, we were able to manage only one interviewee i.e. project manager.

Table 1. Details about SSDSs and interviewees

SSDSs	Total Employees	Expertise	Software Shop category	Interviewees
Software Shop A	8	Web application design & development	Project based	Project manager & senior developer (PM & SD)

		(WAD & D)		
Software Shop B	8	(WAD & D)	Project based	(PM & SD)
Software Shop C	7	(WAD & D)	Project based	Project manager
Software Shop D	5	Utility applications	Product based	Project manager
Software Shop E	9	(WAD & D)	Project based	Project manager
Software Shop F	8	(WAD & D)	Project based	Project manager
Software Shop G	10	Financial applications	Product based	Project manager

Each interview was face to face with duration around 45 minutes. All interviews were recorded on a handheld smart device as audio files. The first two interviews were transcribed and analyzed prior to the subsequent interviews in order to improve questionnaire and interview technique.

Semi-structured interviews (open-ended) technique have been used to elicit data because semi-structured interviews provide a freedom of information (exploratory in nature) to the participant involved, it is flexible, and it provides opportunity for the interviewers' improvisation and exploration of the studied objects [9].

4 Project Management Practices in Pakistani Small Shops

4.1 Key Characteristics of PM Practices in Pakistani SSDSs

Through our analysis we identified six key characteristics of PM practices in Pakistani SSDSs.

- Many Intermediates
- Non-Standard PM tools
- Customer Dictates
- Multiple Responsibilities
- No Access to the End User
- Lack of Project Management Training

4.1.1 Many Intermediaries

The companies get about 60% to 70% of their business from bigger software development companies operating in US, UK, and Australia. There was only one company who strives to get its business from the local Pakistani market. According to this SSDS, online business is gaining pace in Pakistan and has a bright future,

meaning more local business for the SSDSs. The other SSDSs perceives the Pakistani web market as immature and most business owners do not see how the web can benefit their business. They further added that the local clients pay too little for their websites.

The final or end customers of the Pakistani SSDSs who work for overseas clients are located in US, UK, Australia, or South Africa. They comprise a variety of on-line businesses; e.g. small online businesses, real estate business, online shopping carts, and social networking websites. Other clients are brick-and-mortar companies or individuals like barbers, designers, shop owners, reporters, and celebrities. The SSDSs in Pakistan and the final customer are however, isolated from each other by several intermediate layers: Often, the SSDSs, find their customers through online freelance portals/websites. The clients posting projects on these websites may be the final customer, but can also be an intermediary located outside Pakistan; e.g. in USA, UK or South Africa, who receives businesses from their local clients and so forth. Larger projects ($5000 plus) may be handled by another intermediate company who in its turn engages an IT consulting company (having excellent knowledge of web technologies) to prepare a requirements specification document (RSD), for one or more overseas web development companies like SSDSs in Pakistan. Thus, up to four layers may separate the end user from the SSDSs in Pakistan.

The chain may be even longer, however, since the Pakistani SSDS may choose to engage another local company to develop all or part of the project. Figure 1 illustrates the different trajectories and intermediate layers in this network.

The long chains result in delays in feedback from the end-customer to the SSDS. If a project has been delivered in two months, then the SSDS may wait for 2-3 months up to a year before the client returns with the end-customer's feed-back.

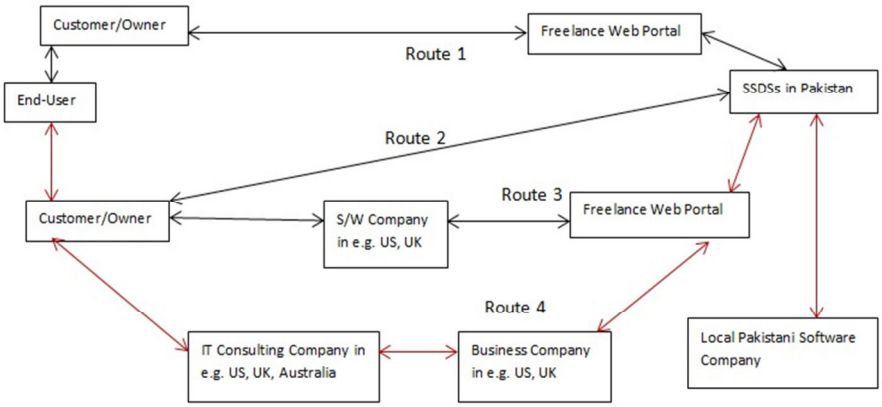

Fig. 1. Business layers between end-user and small shops in Pakistan

In other cases, for very small web projects, either the clients approach SSDSs in Pakistan directly or a local (to the end-customer) intermediary outsources projects to Pakistan.

4.1.2 Non-Standard PM Tools

There is a long range of software development and PM tools available. These tools have been used throughout the whole software development life cycle (SDLC) i.e. PM, requirements engineering, design, implementation, and software testing. [1] In the case of SSDSs, the respondents claim that current standard PM tools do not fit their requirements. Project managers complained that the available PM tools are time consuming and complicated to use. They need a time efficient tool that can help managing around 20 small web projects simultaneously. Therefore, some SSDSs have studied four or five PM tools and have modified them to fit their requirements. By using these tools, the project manager can organize projects and tasks. He can communicate with developers and clients. He can instruct his developers about any task or project, clients can see status of their projects, the project manager and developers can upload and download files, and the tool also maintain history of all projects. There was only one interviewed SSDS that was using some features of MS Project tool and another SSDS using MS Team Foundation Server (TFS) to keep track of their projects.

4.1.3 Customer Dictates

In the project based SSDSs, the client often dictates project parameters; i.e. cost and duration of a project, and their feedback drives development activities. Customers control finalization of a project, they have access to PM tools at SSDSs to see the status and give feedback against their projects, and they have access to local developers and project managers and assign them tasks and dictate the process to be followed. One client, for example, has given Company F access to their online PM tool called PM Bubble. The project manager from Company F can get project details like number of tasks, project cost, start time, completion time, and comments about the project, and he is required to update project status through this tool. On the other hand, product based SSDSs have their online customer support system to get feedback from their customers/users and they don't face customer dictation but they get new requirements, or bugs to fix.

4.1.4 Multiple Responsibilities

Most employees in the SSDSs have multiple responsibilities. Project managers also participate in software development, software testing, business development, and other managerial tasks. Software developers are also responsible for software design, and software testing. Some SSDSs give their clients direct access to the developers or web designers so that clients can give feedback on project status. In this way, clients do project monitoring and controlling of their projects that actually are responsibility of a project manager. Sometimes a client takes all responsibilities of a project manager and he considers SSDS as his development team. One of project manager told the authors that some of their clients outsource them front-end web development and website maintenance projects. For these projects, clients define task in an online

PM tool (i.e. PM Bubble) and give the project manager access to this tool to get project details i.e. number of tasks, project cost, start time, completion time, and comments about the project.

4.1.5 No Access to the End User

By 'end user' we here refer to an individual or a group of people who uses the final product. In some cases, a customer/client could be a user but if the product has been made for an open market then user and customers are different identities. [15] It is possible that client's needs differ from those of end user's needs. Therefore, it is very important to get input and feedback from end users during a development process [15]. The SSDSs in our study, however, are isolated from the end-user by several layers of intermediaries, as described above. In fact, they rarely even have access to the customer who originally ordered the product, but only to an intermediary, who, in his turn, may also be several steps away from the customer and end-user. In this way, project managers at SSDSs in Pakistan are sometimes unable to get real client input and feedback needed to run a successful PM process.

The many layers of intermediaries have economic implications for the SSDSs as well, since the client does not pay the SSDS until the final product is operational and approved by the original customer. This process, which may involve activities and components outside the control of the SSDS, can delay payment from anywhere between two months to a year. During this period, SSDSs may still receive requests for small changes and bug fixes.

4.1.6 Lack of Project Management Training

Most of our interviewees are the owner of their companies and they have a bachelor degree in Computer Science or Information Technology. They don't have specific IT PM training or certification but have switched from being an experienced software developer to the role of PM. One young project manager even hasn't proper education in computer science and he switched from in-process Chemical Engineering degree to software development. In the start he got expertise at Photoshop and other website designing tools and gradually he made it his profession by picking up projects from freelance websites. When he found himself more involved in these activities and he got business beyond his limits then he decided to open a company

The project manager from Company E, on the other hand, has a Master degree in Software Engineering but he also started his career as developer and after five years of development experience he switched to PM. Normally all project managers at interviewed SSDSs don't feel lack of PM training for their routine PM activities but when they get a bigger and complex project then they feel to make things formal. What makes project managers confident about running successful PM process at SSDSs; is their experience from previous projects

5 Discussions

Our discussion and analysis based on the data collection from Pakistani SSDSs, and literature review, will be presented in two parts. The first part describes that how well Pakistani SSDSs perform in the context of PM practices, and what kinds of challenges they face. In the second part it is analyzed that what are the implications of key characteristics of PM practices in Pakistani SSDSs and what types of challenges they offer to SSDSs.

5.1 PM Body of Knowledge and PM practices in Pakistani SSDSs

In this section, we present the best practice benchmarking by considering six benchmarking indicators recommended by PMBoK i.e. Project Planning, Project Staffing, Project Execution, Project Monitoring, Project Controlling, and project closing as shown in table 2. The purpose of this benchmarking is to learn how well Pakistani SSDSs perform in the context of PM practices, to evaluate why these small firms are successful or unsuccessful in the provision of quality software products, and as result of implications of this benchmarking; what types of challenges SSDSs are facing?

5.1.1 Project Planning & Project Staffing

The PMBoK represents a comprehensive set of project planning activities e.g. development of project plan, scope definition, collect requirements, estimation of time, cost, & resources, creation of work breakdown structure (WBS), risk management plan, quality plan, development of human resource plan, and so on. Besides PM planning processes, PMBoK has also given tools and techniques relevant to each project planning activity e.g. Expert Judgment technique for developing project plan, Focus Groups, the Delphi Technique, Brain Storming techniques for collect requirements process, Bottom-Up Estimation techniques for resource estimation, and Analogous Estimation, Parametric Estimation, and Three Point Estimation techniques for time estimation. [21]

Table 2 shows three columns describing PM process components from PMBoK in the first column, actual PM practices in Pakistani SSDSs in the second column, and anonymous references of SSDSs relevant to PM practices in the third column. Table 2 shows that for project planning & project staffing; most of SSDSs perform project estimations on the basis of their experience and not a single SSDS writes project plan document. Little less than half the SSDSs plan their project activities by using PM tools. There was only one SSDS which was using Three Point Estimation technique to estimate project budget and project duration. In all SSDSs, resource estimation is done on the basis of experience and they don't make a plan for resource management. In most of SSDSs, tasks are assigned by informal mutual discussions and in some SSDSs project manager assign tasks/project on the basis of his familiarity with developer's expertise or his experience form previous projects.

5.1.2 Project Execution

During project execution the project manager coordinates and integrates staff and other resources, and he performs project activities in accordance with project management plan. These activities may include changes to expected project duration, changes in resource productivity and availability, and changes in project plan documents to satisfy project objectives and customer's needs. [21]. Table 2 illustrates that, during project execution process in most of the Pakistani SSDSs, project managers coordinate the developers by emails, informal face-to-face meetings, and whiteboards. In three out of seven SSDSs, project managers are also using PM tools to coordinate with their developers in accordance with project plan.

Table 2. PMBoK process components and PM practices in Pakistani SSDSs

PM Process Components	PM Practices in SSDSs	SSDSs and their relevant practices
Project Planning & Project Staffing	a) Project manager keeps project plan in his mind but not on a paper or document b) Project Manager uses email and Skype history to maintain information about each project e.g. project time, cost, duration, client name, start and end date, requirements changes, and client's comments & feedback against each project. c) Project manager use PM tool to plan the project management activities d) Estimations are done on the basis of experience e) Cost and time estimation by using Three Point Estimation technique f) Clients decides the cost, and project duration g) No project plan documentation h) Project manager estimate resources on the basis of his experience from previous projects and he also held short meetings with developers to estimate resources required i) Tasks are assigned by mutual discussions among project manager and developers	• Company A (a, b, c, d, e, f, g, h) • Company B, C, E, G (c, d, f, g, h, i) • Company D, F (a, b, d, f, g, h)
Project Execution	a) Project manager coordinate the software developers and other employees by using PM tool	• Company B, C, E (a, b c, d) • Company

	b) Informal face to face meetings, emails and white boards are the means of communication among project manager and developers for project coordination c) Clients use PM tool to coordinate with developers at SSDSs d) Developers have access to PM tools and they can see any update regarding their tasks e) Major changes in time, cost, and resources are made if SSDSs get new but big requirements or big changes.	G (a, b) • Company A, F, D (b)
Project Monitoring & Controlling	a) Project manager monitors and measures project progress by using PM tools and give their feedback to take corrective actions b) Project manager monitors and measures project progress by walkthrough encounters, emails, and short meetings. c) Clients monitors and measures project progress by using their own PM tool and give their feedback to take corrective actions d) Clients monitors and measures project progress by using PM tool provided by SSDS and give their feedback to take corrective actions e) Developers have access to PM tools and they can see any update regarding their tasks	• Company B, C, E, G (a, d, e) • Company A, D, (b) • Company F (b, c)
Project Closing	a) Project manager test and verify software product against the needs of a clients and then he finalize product release b) Client test and verify software product or a task (e.g. front. end design) and finalize the completion of a project	• Company A, B, C, D, E, G (a) • Company F (a, b)

It has been mentioned in section 4.1.1 that clients/customers also take part in project management activities. For this purpose they coordinate with project managers at SSDSs, in some cases (company D,E), they coordinate directly with developers via their own online PM tools, by emails, Skype, or by PM tools developed by SSDSs. In these cases clients dictate project parameters; i.e. cost and duration of a project and their feedback drives development activities. They finalize the completion of a project, they have access to PM tools at SSDSs to see the status and give feedback against their projects, and they have access to local developers and project managers and assign them tasks and dictate the process to be followed.

PMBoK has mentioned sub processes of project execution process e.g. Perform quality assurance, acquire project team (confirming human resource availability), develop project team (of improving the competencies, team interaction), and distribute information (making relevant information available to project stakeholders as planned.). PMBoK has also provided tools and techniques to run these sub processes e.g. Quality Audits, and Process Analysis techniques for perform quality assurance process, Pre-Assignment, and Negotiation techniques for acquire project team process, and Interpersonal Skills & Team-Building Activity techniques for develop project team process. It has been noted during interview data analysis that there are a few techniques recommended by PMBoK, have been unintentionally practiced by SSDSs in Pakistan. For example Company C practices Pre-Assignment technique, Company A practices Three Point Estimate technique, and somehow all companies are practicing Interpersonal Skills technique for project team development. But the rest of preceding sub processes and techniques relevant to project execution, have not been practiced in SSDSs in Pakistan.

5.1.3 Project Monitoring & Controlling

In project monitoring and controlling (PM&C) process; project performance is measured and observed regularly and consistently to notice deviations from the project management plan. The PMBoK has given ten sub processes relevant to PM&C process e.g. perform integrated change control, verify scope, control schedule, control cost and so on. For each sub process of PM&C process, various techniques and tools are associated which help to run these processes. [21] For example Performance Review and Variance Analysis techniques for control schedule process, Inspection technique for verify scope process, and Expert Judgment & Change Control Meetings for perform integrated change control process. [21] If we look at table 2, it articulates that SSDSs in Pakistan are for away from practicing processes and techniques defined by PMBoK. In most of SSDSs, project managers monitor and measure project progress by using PM tools and give their feedback to take corrective actions. But in some SSDSs, project managers perform PM&C by walkthrough encounters, exchanging emails, and by holding short informal meetings.

5.1.4 Project Closing

Project closing process ensures and verifies the completion of all activities across all PM processes. To finalize the closure of a project, project manager can obtain acceptance by the customer/owner, conduct post-project review, record impact of tailoring to any process, or he can document lesson learnt. [21] PMBoK has proposed two sub processes for project closing phase i.e. close project, and close procurements. Techniques associated with these processes are Expert Judgment for close project process, and Procurement Audit, and Negotiated Settlement for close procurements process. It has been noted in table 2 that in most of SSDSs, project managers test and verify software product against the needs of a clients and then he finalize product release. Therefore it is acceptable that most of SSDSs are following Close Project

process and they are also practicing Expert Judgment technique to finalize project completion and to some extant SSDSs are also practicing Negotiated Settlement technique, because project managers often solve their disputes with by conducting negotiation sessions with their clients or customers.

5.2 Pakistani SSDS Challenges

The issues and challenges facing the Pakistani SSDSs have implications on their PM practices. The project managers' multiple responsibilities keep them away from practicing thorough PM activities. They spend a larger part of their time in communication with clients and with developers and also take part in software development, and testing. Therefore, it is very difficult for them to develop and maintain project plans, systematically monitor progress, document activities or perform systematic project evaluation. In [24] it has also been reported the implications of multitasking by adding that assigning multiple projects/tasks to an individual enables companies to use developer's expertise for different roles and for different types of projects. In this way, the company can reduce time and resources that are not in use. To show progress on all tasks and responsibilities; developers do work in time-sharing manner. But during this process; project completion is slowed down, time is consumed in learning things, forgetting, and then relearning. In case of the SSDSs, besides having many tasks/responsibilities, developers/project managers also have to deal with updates, defect handling from clients, and problem-solving meetings. Excessive multitasking for an engineer causes disruption and fragmentation in work, and it provides less opportunity for recuperation, and competence development. [24]

The Pakistani SSDSs are positioned at the very end of a long (global) software development chain where a task or project has passed through three to five business layers before reaching the SSDS in Pakistan. The many intermediaries create a communication gap between Pakistani project managers and developers, and the end-client/user. Information distortion in long - indirect - communication chains is known to result in ambiguities between clients and suppliers [26]. When a requirement from the end client, travels through all layers and reaches the project manager sitting in Pakistan, then it is not guaranteed that this particular change request is the same as the end client requested. In a similar way, if the project manager sends a mock up for a web page or a request for further information then the same problem occurs. It means that multiple business layers also do cause misunderstandings, and ambiguities between the end clients and project managers in SSDSs. Thus, the many intermediate layers impact the quality of a project Delays in client/customer feed-back also keeps the project manager from planning and performing further software development activities, thus creating problems for resource planning and project delivery.

The end-user's involvement in the development process improves the chance of success of a project and its quality [15] but the SSDSs in Pakistan do not have access to the end users, only to the clients who pay them for a project.

In case of project based SSDSs; customers keep certain controls of PM responsibilities in their hands. Customers fix the cost of a project, they fix the duration of a project, their feedback drives the project development activities, they

have access to PM tools at SSDSs to see the status and give feedback against their projects, they have access to the developers and they can dictate them, and sometimes they dictate project managers at SSDSs to follow their own defined PM activities. In this way, the local project manager loses control over project planning, scheduling, project directing, and project controlling. We have mentioned above that 60 to 70% clients of SSDSs are big software companies and probably this attitude of giving dictations to SSDSs have been developed because the size of SSDSs is very small, clients knows that SSDSs are immature, and clients also know their financial limitations. But this attitude from bigger companies would make problem for project managers at SSDSs to be a confidant project manager.

Most of SSDSs that we interviewed don't use standard PM tools; e.g. MS project. They find these tools complicated and time-consuming to use. Consequently, project managers at these SSDSs are facing omission of data, and rework issues because simultaneous they have many projects in running mode, and they have to deal with changes and updates for already delivered projects. Further each employee has multiple responsibilities which also contribute to make things messy. Therefore in this case, without PM tool support, it becomes difficult to keep track of information regarding each project. But on the other hand, two SSDSs have developed their own PM tools and these tools are exactly according to their PM requirements. The SE literature states that SSDSs have a perception about SPI standards that they are overly involved, complicated, missing detailed implementation guidance, and they require extra resources that would be additional cost to the company. [2] SSDSs are unable to afford the cost of extra resources and they don't see any net benefit in applying software processes, models (CMM, CMMI) or standards (ISO/IEC 12207). [2] Therefore the trend of making existing SE tools, techniques, models, and SE standards according to the requirements of SSDSs should be promoted in SE literature.

All project managers at SSDSs in Pakistan have moved from software development to project management. They don't have specialized training in PM and PM tool usage. Consequently they are unaware of PM methods and PM techniques, and they are totally away from current research in PM area.

The six characteristics of Pakistani SSDSs described in section 4.1 also have implications on project planning activities (see table 2). If we assume that SSDSs are following project planning activities as recommended by PMBoK, then due to multiple business layers (section 4.1.1), the issue of information distortion and ambiguity still remains there. This issue can cause major changes in project scope, cost, time, and project effort. Multiple responsibilities of the project manager are another factor which can keep them away from formulizing the project planning activities. Suppose if project managers are ready to give proper time to project planning activities then a question rises that do they have enough expertise for this? According to our study; most of the project managers at SSDSs don't have proper training or certification in project management and it would be very difficult for them to follow planning processes recommended by PMBoK.

If we talk about the best practice benchmarking in context of PM practices in SSDSs then section 5.1 shows that, SSDSs in Pakistan are far away from practicing PM process and they are not ready to improve their PM process. This farness from real PM practices has stuck their growth and provision of quality products because

process improvement is very important for company's growth and it plays major role in providing quality products [23]. This farness contributes to their problem of information distortion, omissions, project delays, less productivity, and weak quality. It also shows their trend and attitude towards practicing other SE disciplines like requirements engineering, configuration management, software design, and software testing.

6 Conclusions

Our results show that Pakistani SSDSs are facing many challenges related to PM in the local as well as global context. Locally they are facing challenges of multiple responsibilities, lack of PM tools that can fulfill their unique PM requirements, insufficient PM training, and unavailability of end-users who play important role in project success. Globally they have to face PM dictations from their clients (mostly software companies), they face many business layers to get business and to communicate with their clients regarding PM activities, and they are facing problems of information distortion, misunderstandings, incompleteness, delay in payments and delay in project delivery. These business layers also keep SSDSs away from practicing agile methodologies because agile methods purely focus on direct and face to face communication among individuals (customer-developers) that in case of most of Pakistani SSDSs, is almost impossible. [26]

The best practice benchmarking performed in section 5.1 has proved that the actual PM practices in Pakistani SSDSs do stay far away from PM practices recommended by PMBoK. Due to poor PM practices, SSDSs get stuck in their growth and provision of quality products. All project managers at SSDSs have very little knowledge with PM processes, tools, and techniques recommended by PMBoK in [21] that shows lack of interest in learning and adopting real PM practices, and it confirms that they don't have proper PM training and PM education.

It is clear from above discussion that the Pakistani SSDSs share many of the characteristics previously reported from the publications of SSDSs in other settings. These characteristics include multiple responsibilities, short time to market, managerial crisis, ad hoc project planning, lack of documentation etc. [5, 3, 2, 25] We can assume that the commonality of these characteristics is a result of common structural and contextual properties of the SSDSs; e.g. financial limitations, narrow skill base, time constraint, lack of learning opportunities etc. what makes Pakistani SSDSs different from previously investigated SSDSs in other setting; is the long and complex software production chain. The overseas clients separated by possibly two to five intermediate layers have shaped a complex global software production chain arrangement (figure 1) and this arrangement has yields delays in communication between the SSDS and the end customer, ambiguities in the requirements, delays in payments, and it increases the risk of communication distortion.

These observations open further research into the exploration of additional global software production chain arrangements in other settings, their characteristics, and how these arrangements influence PM and software development process within the organizations in developing countries and also in global context. These observations

also motivate to conduct systematic comparisons between SSDSs in the developing and developed countries.

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