



Review Paper

Software Project Management in Developing Countries: Landscape, Literature Review Framework and Opportunities

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Abstract

Country specific research on Software Project Management (SPM) is becoming an important issue specially in developing countries (DC). A review of such literature published in international journals and as theses is conducted and is presented in a meaningful manner which is helpful in drawing inferences and in guiding the future research. Instead of identifying factors hampering the growth of SPM in DC, focus is on what problems have so far been addressed by the researchers; collectively these problems are specified as themes. These themes are recognized as the current research trends in SPM in DC. In conclusion, it is found that more research is required in the area of SPM in those DC that are growing as new software exporters such as Pakistan. Most of the research in SPM in DC is reported by the researchers from major software exporting but developing nations such as Brazil and India. It is also found that the current research in SPM in DC is at best outward with only discernible issues addressed without in depth exploration. New research opportunities in SPM in DC are also identified.

Keywords: Software project management, software engineering, developing countries (DC), literature review framework.

Introduction

Software project management (SPM) is a specialization of general management studies that utilizes the typical management skills of planning, organizing, staffing, leading or directing, and controlling to achieve defined project objectives¹. Though project management (PM) practice exists for a long time, however, the history of SPM is not as old. In fact, most theories of SPM are taken from the historically established PM practices in other fields such as civil engineering.

Futrell et al.¹ describe the advent of SPM as in late 60s when software engineers from 11 different countries attended a North Atlantic Treaty Organization (NATO) Science Committee conference in Garmish, Germany. While most discussions were focused on the technical aspects of design, production, implementation, distribution, and service of software, there were also reports on "the difficulties of meeting schedules and specifications on large software projects." Futrell et al deduce that this may have been the first public recognition of the importance of SPM. This led to the development of a software life cycle (SLC) to represent the sequence of events that occur in software development. In 1970, W.W. Royce identified several phases in a typical SLC. Royce and Barry Boehm's model was informally labeled the "waterfall model" SLC. Since the phases of their model and others can be mapped to the PM process groups which are initiating processes, planning processes, executing processes, and closing processes therefore one may infer that the SPM was born in 60s and 70s with the birth of SLCs.

Though, the western and European countries adopted SPM long ago, in developing countries (DC) the adoption of SPM theories is still evolving. The unique problems that the DC presents such as social, cultural, political and communication barriers are not present in the countries where SPM practices were born. The slower adoption of SPM in DC warrants that research is required to modify or tailor the existing SPM theories to make them consistent with their working environment.

Several researchers have already realized a need of developing country-specific research in SPM. Over the years, several high quality research papers and doctoral theses have been published based on the argument that DC differ from the developed countries in several ways, therefore their theories are not directly applicable in DC.

The main aim of this paper is to highlight those issues in SPM in DC that researchers have so far addressed. To achieve this aim, research journals, conference proceedings, and doctoral and masters' theses published on SPM in the context of DC are reviewed. These research publications are content analyzed to assess the prevailing research trends as well as overlooked areas in SPM in DC.

In the next section, an overview of the SPM is provided to quickly introduce this area of research to the readers. In the later section, those issues that the researchers have been recognizing in the field of SPM all over the world and not just the DC are

highlighted. The factors that affect or hamper the growth of SPM in DC are highlighted next. Later the data collection and analysis technique used is discussed. Those themes that have emerged from the literature review are presented next along with the key references that enabled the emergence of a particular theme. A literature review framework follows this presentation of themes. Later in the discussion section, current research trends, limitations of current research landscape and research opportunities in SPM in DC are discussed. This is followed by a brief conclusion section.

This paper, which is a result of an ongoing doctoral research, is written in such a form that the reader may use it as a literature review that identifies the current trends in SPM research in DC, as well as an essay on what is SPM, the major issues that needs to be addressed as well as the issues that resists the growth of SPM in DC and an identifier of new research opportunities.

Overview of Software Project Management

Practice of managing projects is evolving for a very long time. The construction of the pyramids in Egypt (2,550 B.C. in the case of the Great Pyramid of Giza) and the Great Wall of China (221 - 206 B.C.) shows evidence of the practice of PM since a very long time². The theories and concepts in PM used today are far better as compared to the theories of the past. Today, PM provides us with effective theories for planning, systematizing, and managing multifaceted activities for accomplishing specific tasks. Talking in terms of software development, Jurison³ noted that it benefits greatly from effective PM. Jurison³ noted that software projects are generally multifaceted and their development takes place in a dynamic setup; they are also prone to changing business conditions and technologies during the project. He further noted that the users often lack confidence in their needs and repeatedly change requirements in the middle of the project. He considers the difficulties in SPM are due to the nature of the product and due to the management of the project. Jurison³ noted that some difficulties in project management are: missing targets that indicates project progress, complexity of software, changing and poorly defined requirements, poorly planned project, impracticable deadlines and allocated budget and how people approach management of a project.

In his opinion the purpose of PM is to provide focus for using the resources to accomplish specific goals. Many researchers including Jurison³ believe that fundamental objective of PM is to reach the objectives within suitable time limit and cost and performance level that satisfy customers. These dimensions provide the focal point for all PM efforts. They are also the constraints within which PM operates.

Jurison³ noted that all projects progress in a series of phases. Each phase illustrates the type of tasks to be performed and decisions to be made. These phases are referred to as the project's life cycle. These phases help project managers to systematize the work and to assign and manage resources for the

achievement of the goals. Similarities can be found in different life cycles; all projects can be seen as organized in four broad phases: "project conception, planning, execution, termination"³.

Though the life cycle systematizes work on a project, however, executing these phases and eventually the success of software development project is strongly related to planning. Jurison³ and many others have noted that many project failures can be traced to poor planning. Jurison³ noted that planning for a software development project includes the following activities: it depicts generally the approach to software development, specifies deliverables and required resources, schedules, budget, risk factors and their management and organizational responsibilities. Project planning concludes in clear project definition and clear specification of development process, cost estimation and risk assessment techniques. Strict adherence to a well developed project plan, leads to successful completion of projects.

An important aspect of SPM is project organization. This aspect deals with the people issue. Success and failure of any project relies on the team that works on it. A successful team in turn relies on well defined hierarchical organization in which they are working. Recently, the issue of project organization is garnering increasing interest of researchers. Jurison³ noted that project organization identifies how a project manager should be selected, his capabilities and the characteristics he should have. It also identifies how project team should be selected, individuals' capabilities and their characteristics. Lastly, project organization also defines structure of a team.

The teams, plans, phases and all resources of a project are executed in the confines of several processes in a project³. The processes included in SPM are: project control, cost and schedule, technical performance, change and configuration and project evaluation processes.

In conclusion, following critical factors are involved in SPM: clearly defining objectives, top management support, realistic budget and schedule, client/user participation, project leadership, project reviews, change management, communication, and problem solving.

Since the projects are completed by a team, therefore the role of teambuilding in SPM cannot be emphasized enough. Efforts on motivation, communication and conflict resolution are undertaken throughout the life of a project for completing it successfully.

Major Issues in SPM

Major issues identified in research on SPM globally (and not just DC) are presented briefly in this section. The aim is to introduce them to the reader without going into the detail of each identified issue.

Major Issues Identified in SPM: In 1981 Thayer et al⁴ noted that much work has already been done on the technology that facilitates the software engineering. Many major concerns related to the availability of technology for software production have been addressed. Significant tools to support enhanced software production are readily available. He noted that yet major advances in software engineering project management (SEPM) are still awaited. He further noted the paradox that software developers who have demonstrated competence as developers and programmers have been elevated to project managers without much training in this regard. Along with this paradox, Thayer et al⁴ went on to identify 20 problems in SEPM. These problems were grouped into 5 major categories of issues which were further divided into 20 issues. The figure-1 shows the 5 major categories of issues.

Thayer et al⁴ further divided planning problems into the following issues: absence of “plan requirements” to deal with regularly partial or incoherent and unmeasurable requirements; Conditions of success criterion for software development is missing; planning and scheduling specifications for software development projects is also not available;



Figure-1
Five Major Issues in SEPM by Thayer et al., 1981

Similarly, development of the ability to approximate correctly the cost and resource requirements and accurately predicting the release time of software is poor; Rules for choosing the acceptable software design techniques, equipment, aid and selecting the correct measures or plans, and tools to be used in assessment of developed software are also missing. Similarly, techniques or strategies for crafting maintainable software are not available; methods to assure that the delivered software will work are not available; and procedures and methods for designing a project control standard that will facilitate project

managers to successfully manage their project are also not available.

Thayer et al⁴ divided the organizing problems further divided into the following issues: Decision systems for selecting the proper hierarchical structure of staff are not available. Moreover, the accountability structure to account for several issues (such as overrunning cost and time) in many software projects is largely unavailable. Thayer et al divided the staffing problems further into the following issues: Measures and criterion for selecting the managers and management staff are poor.

Thayer et al⁴ divided the directing problems into the following issue: rules for use in choosing the proper management practice for project management are not available. Thayer et al⁴ divided the controlling problems into the following issues: Measures and indicators to monitor the progress are not available, similarly, indicators of reliability, maintainability and reliable coding of software is not available. Moreover, standards and techniques for measuring the performance of programmers and data processing analysts are not available. Lastly, aids to monitor a software development process are not generally available.

Interestingly, even several decades after this research these issues have not been resolved completely. In fact after nearly three decades Nguyen⁵ found the similar problems as identified by Thayer et al⁴ prompting that much research is still required in SEPM.

Some Factors Hampering the Growth of SPM in developing countries

Software project management in DC is a rather more recent phenomenon, as the use of information technology (IT) in DC is far behind that in developed countries, due to differences in economic, social and political environment. The differences or unique issues that hamper the growth of SPM in developing countries are identified by different researchers. Some of these factors are given below.

Mia et al.⁶ delineate several factors that hamper the software projects in DC. He found that irrelevant education of IT project managers hinders the growth of SPM. This is emphasized by Peterson et al.⁷ who described the mismatch between the educational background of project managers and the nature of projects in DC as a reason for slower growth of use of SPM practices. In many cases IT project managers with very low or no background of IT education are appointed, which obstructs the success of projects in many ways. Another factor that Mia et al⁶ noted is the lack of planning of projects. Projects are likely to suffer throughout all the phases of SLC if proper planning is not followed. It is a common phenomenon in IT project management in DC that projects start without proper planning. This also leads to a tendency of skipping essential steps of PM

in all phases of the project. Project management without proper planning results in failure or so-called ‘unsatisfactory successes’ of projects. Another factor that hampers the growth of SPM is unwillingness to use tools and techniques. IT project managers are reluctant to use the scientific tools and techniques for PM. They try to proceed with the project using traditional management thinking. This attitude or inability of using the proper tools and techniques hampers timely completion of projects with expected quality. Knowledge gap also hampers IT projects during development and implementation.

Another reason of slow growth of SPM in DC is political problems in the country. Although Stuckenbruck and Zomorrodian⁸ long ago described the political problems that hamper PM in DC, these problems still exist, perhaps in slightly different forms. In particular, IT projects having links with the government are very much affected with illogical interruptions, and with politically-backed incompetent and corrupt people.

Another factor that can be ascertained from Muriithi et al.⁹ is the lack of research in SPM that fits the working environment of DC. He quoted Turner¹⁰ while observing that opposing to the common convictions that the Western born techniques of project management can be applied globally, substantial cross-cultural problems in their use especially in developing countries or in non-Western Countries is reported.

Data Collection and Analysis

Data for this research includes research papers and research theses. Only one publication of an author with multiple publications on the same issue in SPM in DC is selected. No effort is made to report the contribution of the selected research publications. Only the issues that are addressed in a research are

captured. Moreover, the exact environment in which the research was conducted was considered as outside the scope of this paper mainly because the emphasis was not on the individual differences between the environments of different organizations of DC. The figure-2 generally shows which search strings were used in data collection.

Once the publications of interest were collected, a thematic analysis of these publications was conducted. Braun and Clark¹¹ as well as Boyatzis¹² and Roulston¹³ notes that thematic analysis is the most widely used and least acknowledged mode of qualitative data analysis. Braun and Clark¹¹ also revealed that most researchers do not overtly concede the use of this method in research or they use alternative terminology for it, such as content analysis. In fact, Holloway and Todres¹⁴ believes that ‘thematising meanings’ is shared generic skill and is the way the qualitative analysis is normally conducted (as quoted in Braun and Clark¹¹). The flexibility of thematic analysis is one of the reasons for its adoption in this research. Another reason for the selection of this analysis method is because data for this research is in the form of text. Thematic analysis in its several forms is a tested method for this type of data¹⁵.

Current Research Trends in SPM in Developing Countries

Themes that have emerged from the data collected on SPM in DC are presented in table-1. Some themes together gave rise to a major theme therefore they are grouped together. Example references are also given where the reader can find case in point research. The column “summary” presents the objectives of the research briefly and mostly in the original words of the paper’s/thesis’s author(s).

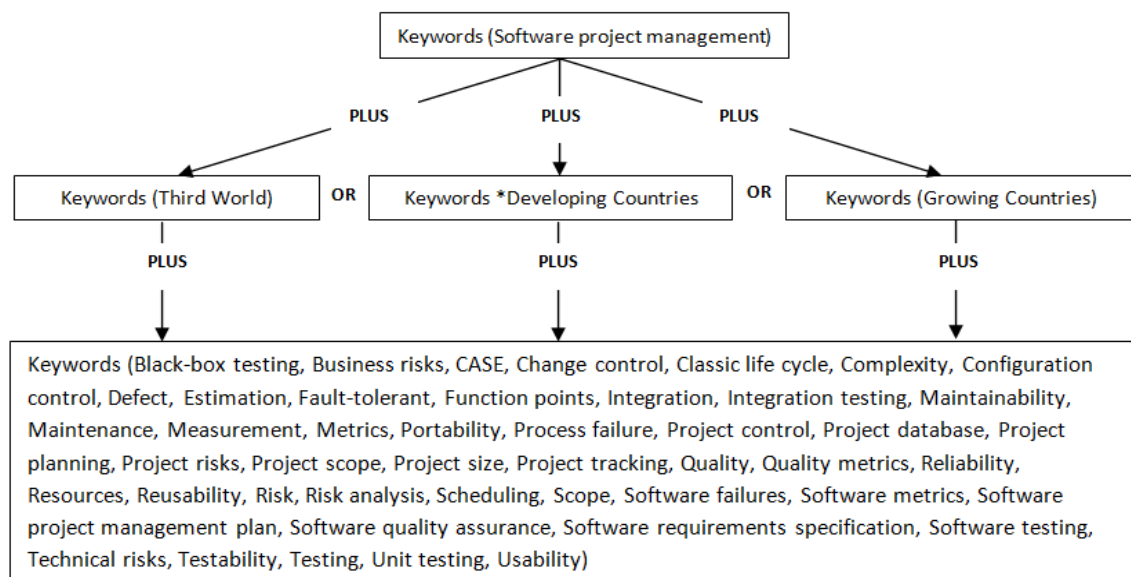


Figure-2
 Search strings for Literature Identification

It can also be inferred that mostly research have targeted those issues that have socio-cultural or communication aspects. Researchers have used different approaches, including qualitative approach (qualitative surveys or questionnaire and interviews). Judging by the number of publications, we can clearly say that more research is required in SPM in the context of DC.

The figure-3 presents a framework to conduct a literature review in SPM in DC. The emphasis of the figure-3 is to show which of the themes are normally linked with each other, such as planning, risk analysis, requirement change management etc and information sharing with the project managers. The triangles shown at the edge of the figure-3 demonstrates that the SPM has effects on outsourcing, type of organization for which the project is conducted and its link with vendor management. At the bottom of the figure-3 there are rectangle boxes that illustrates that the whole practice of SPM in DC relies on the available pertinent theories and education and training imparted to those people who will actually undertake the projects.

A Discussion on SPM in Developing Countries

This paper explores the current landscape of research on SPM in DC and provide and to provide a literature review framework. Our

aim is to provide a significant search of the present body of knowledge in SPM practices in DC and inform intellectuals of further research opportunities in this context. The review of literature has led us to the following conclusions.

The literature has addressed issues on a breadth of topics such as identification of key project management practices, barriers in successful project management, project performance and delivery, environment in which projects work, use of tools and techniques of project management, standards (such as CMMI) followed, team work and team communication, temporal factors involved in teamwork, soft skills of a project manager, project planning, information sharing in SPM, risk analysis, SPM according to the sector such as public vs private, performance assessment of teams, requirement change management including in global scenario, knowledge management, management styles of PM including gender issues, effects of team diversity, team building principles, cultural differences in team members, teaching of SPM etc. It is observed that though so many issues are addressed, none of them are investigated in the required depth. Moreover, most of the work was on pointing out what is missing and very few work actually filled the gaps identified. The overall landscape of SPM in DC warrants more substantial and in depth research.

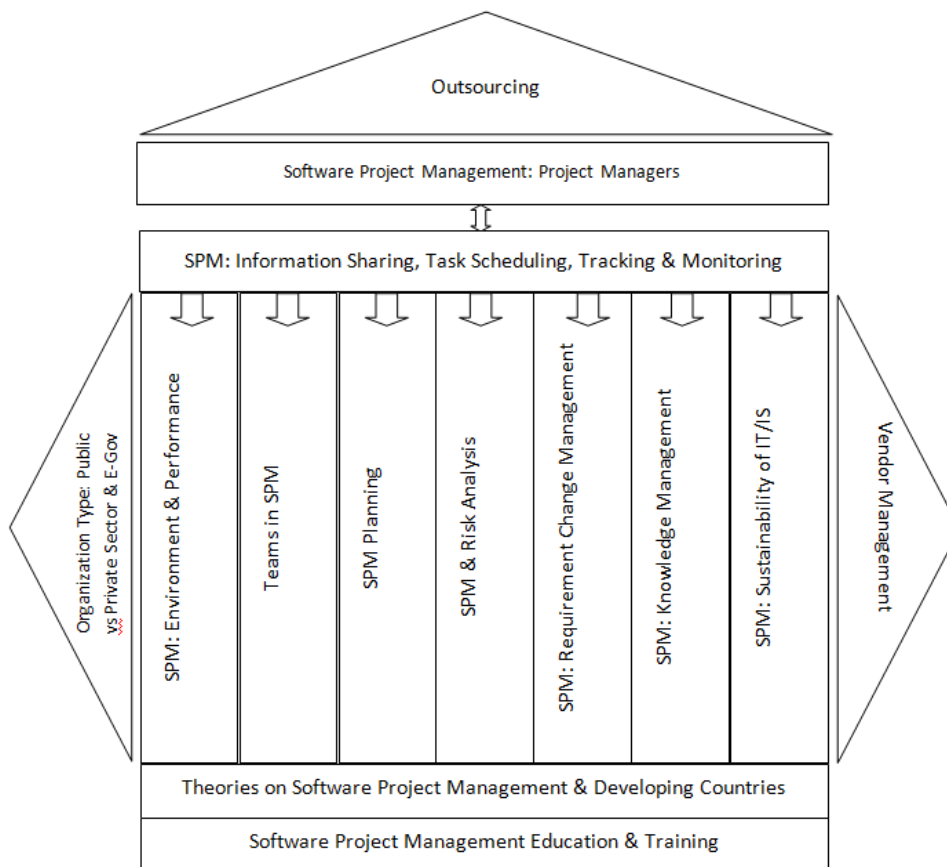


Figure-3
Framework for Review of Literature on SPM in DC

The countries in the tier 1 of software exporting nations (such as India and Brazil) as classified by Carmel¹⁶ had reported most of the research on SPM in DC. These countries classified in tier 1 have advance level of knowledge of software development. Even if these countries will not grow out of the stereo type of developing countries, it can be anticipated that their IT sector will flourish well beyond common expectations. Interestingly, not much research is reported from emerging software exporting countries like Pakistan. The few reported researches from Pakistan and countries with similar scope of adoption of IT are not conducted in depth, thus showing that SPM in such countries is largely unexplored.

Globally research has been conducted in all the project management knowledge areas, which are time management, risk management, integration management, scope management, quality management, procurement management, cost management, human resource management, and communications management. Of these knowledge areas, only few have been studied in DC context. If we look at the themes identified in this paper, a generous classification of them may recognize that these knowledge areas have been given attention by the researchers: risk management, human resource management, and communications management. As each knowledge area is important to project success, it is worth studying issues in all the knowledge areas.

It should also be noted that not all the western project management theories are inapplicable in the DC. In fact, only those theories that are dependent on the unique socio-cultural environment and communication issues that the DC offer need to be addressed by the researchers. The above conclusion can be made from Mursu¹⁷: “The main differences in software development when compared to the industrial countries are in a socioeconomic and infrastructural context, rather than in technical issues”. However other theories should also be tested in scenario of developing countries to check their applicability such as cost estimation, project control, scope management etc.

We are planning to address the issue of scope management in our next research endeavor. It is one of important issues in SPM and it has so far not received much attention in the context of DC. Its importance can be judged from the outcome of Agarwal et al¹⁸; they found that many members of software development teams overwhelmingly consider meeting the scope of software projects as the highest determinant of success.

Similarly, as even the case in global scenario, little attention is given to initiation and closing of software projects in DC therefore research is required on this issue. Research is also required to understand the current level of use of tools and techniques of SPM in DC.

Table-1
Themes Identified from Literature Review

Themes	Summary	Some References	Major Themes
Implication of international PM approaches in a DC	Software development companies only moderately adopt methodologies, models and standards that have shown evidence of success in the developed world ⁹ . Sukhoo ¹⁹ in his thesis looked into the practice of software project management in Mauritius. He argued that based on social, cultural and political scenario it is believed that adjustments are required in software project management framework to fit the requirements of a country. Thus he proposed maturity model for SPM ¹⁹ managing software development in developing countries ²⁰ .	19, 20	Software Project Management Theories and the Developing Countries
Identification of key PM practices	Research is conducted to determine the performance level of projects managed by firms of developing country whilst working in an alien environment ²¹	21	
Transferring PM expertise from Industrialized developed countries	Nguyen ²² looked into how should the theories developed for advanced and industrialized countries can be applied in developing countries. They described and discussed the challenges of transferring modern project management doctrine and methodologies to developing countries, the resulting intricacies as well as suggestions for transfer mechanism improvement.	22	
Maturity of Project Management Practice	Some researchers have also focused on what is current status of software projects based on what the developing countries already have adopted. Sukhoo ²³ reported “on a similar exercise conducted in Mauritius regarding the maturity level of software development projects” ²³ .	23	
Software Process Improvement	Shah ²⁴ studied the status of “Software Process Improvement” using CMMI in a developing country Pakistan.	24	Software Process Improvement

Barriers and Issues in Outsourcing	Some researchers have focused on the issues or barriers that have a negative impact on software outsourcing to developing country ²⁵ . One of these factors is the poor management of software projects.	25	Issues in Outsourcing
Risk factors involved in Outsourcing	Some researchers have used case study approach to identify the “risk factors leading to the failure of outsourced strategic IT development projects” ²⁶ .	26	
Project performance and delivery	Interestingly, some researchers have even questioned the very perception of success in SPM. Agarwal ¹⁸ examined the views of staff such as programmers, and managers and customer support people on what is success. Some researchers looked at different factors that can influence project performance ⁵¹ .	18, 51	Software Project Environment and Performance
Project Environment	Researchers have also discussed the very environment in which the projects are normally conducted. Rozendal ²⁷ argues that the project environment should be divided into a political and a cultural dimension.	27	
Use of PM tools and techniques	Abbasi et al ²⁸ explored the trend of use of PM tools and techniques by the public sector organizations in a developing country.	28	
Globally Distributed Software Development Project Performance	Software firms are increasingly distributing their software development effort across multiple locations. Ramasubbu et al ²⁹ investigated the “effects of dispersion on the productivity and quality of distributed software development” globally including developing countries.	29	
Global Software Development and Requirement Change Management	Requirements change management is considered challenging even in the best circumstances and it becomes difficult when performed on distributed locations ³⁰ . Ramzan et al ³⁰ used qualitative research method to explore requirements change management process in geographically distributed software development.	30, 50	Requirement Change Management and Software Project Management
Teamwork	Research can be found on teamwork focusing how to encourage teamwork, simplify stakeholder participation, and how to monitor students’ work whilst upholding desired collaborative effort ³¹ .	31	Teams in Software Project Management
Team Communication	Papers can also be found on communication as a medium for ensuring the success of projects. Swigger et al ³² examined the global software development process to determine time-variant patterns of communication among student teams globally distributed students’ teams.	32	
Performance Assessment in IT Project Teams	The author of this paper found an interesting piece of work in Butt ³³ . In this paper, the results of survey, conducted to study the self-serving bias in the teams working on the different software projects in a developing country Pakistan’s software houses, are reported. The survey was conducted through questionnaires and interviews among multiple software houses in the Pakistan to study the gap between a person’s own perception about his performance towards the project and the perception of the others towards his contribution.	33	
Effects of Team Diversity for Knowledge Management	Liang et al ³⁴ investigated the relationship between knowledge diversity in software teams and project performance.	34	
Investigating cultural differences in	Dafoulas ³⁵ focuses on effects of cultural differences in virtual software development teams.	35	

virtual software teams			
Effective Team Building and Success of a Project	Bubshait et al ³⁶ presented the theoretical principles of teambuilding and importance of team building and leadership.	36	
Soft skills of IT Project Manager	Some researchers have also focused the project manager soft skills which are acquired through experience, whilst managing and working with people, customers and their needs by creating an encouraging environment for the projects' timely delivery. Sukhoo et al focused on the soft skills of the project manager ³⁷ .	37	Software Project Managers
Management Styles of Software Project Manager	A very pertinent issue is discussed by Qureshi et al ³⁸ in their paper. Their basic idea is to explore which gender is best for the job of software project manager.	38	
Project Planning	Aladwani ³⁹ examined the effect of project planning enabled by project size, complexity, and technicality on IT project success in developing countries.	39	Software Project Planning
Software Agents for improving project management processes (such as efficient task scheduling, tracking and monitoring, as well as effective sharing of information and knowledge)	This is perhaps one of the most interesting themes emerging in SPM. Nienaber et al ⁴⁰ in their paper discussed the utilization of stationary and mobile software agents to be used as a potential tool to improve software project management processes (efficient task scheduling, tracking and monitoring, as well as effective sharing of information and knowledge) to support distributed and centralized software project management.	40	Information Sharing, Task scheduling, tracking and monitoring in Software Project Management
IT PM and Risk Analysis	Both the worth and the limitations of the risk sensitivity analysis techniques are explained by Makhani ⁴¹ .	41	Software Project Management and Risk Analysis
IT PM in Public vs. Private Sector and E-Government	Some researchers have also focused on the organization type and SPM. Syed et al ⁴² has targeted the project management for e-Government programmes in developing countries. They also highlighted the differences in project management in public and private sector organizations.	42	Software Project Management and Organization Types including Electronic based Organizations
Knowledge Management in SPM	Rana ⁴³ conducted a survey to identify the status of the concept of knowledge management in IT organizations and to identify what the companies actually do to achieve consistency across project teams and project.	43	Knowledge Management and Software Project Management
Ontology based approach in SPM	Kumar et al ⁴⁴ formulated a framework for the "successful and efficient requirements management framework for Global Software Development Projects" and apply ontology based Knowledge Management Systems to achieve requirements issues such "as missing, inconsistency of requirements, communication and knowledge management issues and improve the project management activities in a global software" development environment ⁴⁴ .	44	
Vendor Management in Software	Overall the importance of vendor management and the role of vendors in software projects have been discussed based on the literature review of the project management standards and related	45	Vendor Management and Software Project

Projects	literature ⁴⁵ .		Management
Sustainability Analysis Model for SPM	The Mursu ¹⁷ study provides a model for risk management and sustainability analysis for project management.	17	Sustainability of IT/IS and SPM
Teaching Software Project Management	Dannelly ⁴⁶ noted that often the causes of software project failure are not related to incompetency among the software developers, but inadequate skills among the project managers. Qureshi ⁴⁷ has addressed this issue.	46, 47	Software Project Management Education and Training
Personality Styles in Software Engineering Education	Inspired by the MBTI, Capretz ⁴⁸ developed a range of activities for efficient teaching in a software engineering course.	48, 49	

Conclusion

The success of India and Brazil as major software exporting nations has shift the focus of outsourcing towards the DC. The growth in software development industry can only be guaranteed through achieving maturity in SPM practices in DC therefore more research in this regard is the need of time. Moreover, researchers have to play an active role in ensuring maturity of SPM practices in those DC that have just started to acquire larger share of outsourced projects compared to what they have been receiving in the past (such as Pakistan).

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