

Eliciting Theory of Software Maintenance Outsourcing Process: A Systematic Literature Review

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Summary

Software maintenance outsourcing (SMO) is cost effective for developed countries and a good source of getting valuable remuneration package for developing countries. The objective of this paper is to elicit the challenges from literature and to propose an SMO process model to handle these challenges. We used Systematic Literature Review (SLR) protocol for the identification of SMO process related publications in the existing literature. We found 45 studies addressing software maintenance outsourcing challenges with their remedies. We have proposed SMO Process Model / Framework consisting of five practices with their related activities, roles, work products, method and guidelines. We found that most of the existing literature describes SMO process at general level and does not prescribe sequence of SMO process activities. There is a need of industrial feedback on the applicability of the proposed SMO Process Model / Framework.

Key words:

Software maintenance outsourcing; process model, third party maintenance; practices; SLR

1. Introduction

Software systems play a vital role in our daily life. Once the software system gets operational, it enters maintenance phase. Software maintenance is the totality of pre and post-delivery activities to provide cost-effective support to a software system [1]. The maintenance is required to keep the software system operational according to customer needs. There are different categories of software maintenance like corrective, adoptive, perfective and preventive [2], [3]. IT organizations must depute maintenance teams to provide maintenance services. Software maintenance phase is the longest and expensive phase of software development lifecycle as approximately 70% of the total software lifecycle cost is spent on maintenance [8] and [9]. Software maintenance is the last phase in many applications but it requires many efforts [75] and [76].

Outsourcing is the term used when client contracts external vendor to obtain some goods, systems or sub-systems or services like telecommunication services, data entry, maintenance operation, facilities management etc [68]. Software maintenance outsourcing is concerned with subcontracting software maintenance and other related

activities to a third party, at any level, either on shore or off shore [4]. Normally, companies in developed countries outsource software maintenance related activities to companies in developing countries, in order to avail cost effective and efficient maintenance services. Studies reveal that SMO is increasing with the passage of time [5], [6], [7], [40] and [74]. Most of the software companies want to outsource their software maintenance process, so that they can focus on their core competencies in order to improve the effectiveness and efficiency of organization [10]. Obviously, if outsourcing is properly executed, organizations can improve their daily operations along with competitive and strategic advantages (e.g. new product research) [53]. SMO is a complex activity spanning across whole lifecycle of the system involving multiple stakeholders. These stakeholders face many challenges. The challenges begin from early stage of making decision on outsourcing software maintenance and ends with the system retirement [10], [17], [21], [34] and [39]. If maintenance outsourcing process is not managed in a proper way, it may lead to poor quality of maintenance services and in the worst case even in business loss. Although adequate research has been conducted in the context of SMO but most of it is limited to identify and addressing challenges related to SMO process. Unfortunately, there exists no generic process model for software maintenance outsourcing. Our goal is to facilitate SMO industry by proposing a comprehensive SMO Process Model, which has a compliance with the definition of software process model. As according to [42], [43], [44], [45], [47] and [67] software process model or framework may include description of phases (practices), pre and post conditions, product flow, activities, tasks, hierarchy of processes, process performer (role), transitions, work product and methods.

This systematic literature review was conducted from September 2017 to January 2018. It includes papers which were published from 1993 to January 2018. In this paper, we have proposed preliminary version of SMO process model. We have achieved this goal by identifying research gap with the help of Systematic Literature Review (SLR). The remaining of the paper is as follows. Section 2 defines Research Method, Section 3 is about Results and in section 4 we concluded the paper.

2. Research Method

Systematic literature review (SLR) is used as a research method for this study. We followed the guidelines provided by Kitchenham [41] in order to perform SLR. The Research process consists of six activities including (i) informal survey (ii) Define research question (iii) Process of searching (iv) Process of publication selection (v) Process of data extraction and synthesis (vi) Categorization with coding technique. The research process is shown in Figure 1. In following sub-section, these six activities are elaborated in detail.

2.1 Informal Survey

First, we observed the software maintenance industry through an informal survey by following guidelines available in [70]. We contacted 15 large and 20 medium size companies working in different domains like telecom, banking, education, general business etc. The prerequisite for selecting the companies was that they should be involved in software maintenance outsourcing either as acquirer or supplier. We found that industry was facing problems in the context of SMO such as decision of outsourcing, supplier related issues, issues related to contract and execution, risk involved at every stage etc and needed a comprehensive model to handle such issues. This motivates us to conduct a Systematic Literature Review in order to explore the literature for identifying the remedies of SMO problems and provide the solution in the form of a SMO process model.

2.2 Define research question

We formulate the following research questions (RQ) to conduct the SLR.

RQ1: What are the studies discussing SMO related challenge(s) along with the limitations of these studies with respect to SMO process model?

RQ2: What are the limitations of existing SMO models?

RQ3: What practices should be performed during SMO process?

2.3 Process of searching

We performed six major activities for searching relevant literature as shown in Fig. 2. First, we finalized the relevant terms by identifying and selecting them in the context of our research questions. In second activity, we categorize these terms in the columns S1, S2 and S3 as shown in Table 1.

Table 1: Key words used in Review process

S1= String 1	S2= String 2	S3= String 3
Software maintenance	Outsourcing	Process
Software support	Global outsourcing	Process model
	Third party	Framework
	Offshore	Practices
	Distributed	Activities
		Taxonomy

In third activity, we identified and scrutinized relevant synonyms. S1 contains synonyms related to software maintenance. Whereas, S2, includes synonyms related to outsourcing. S3 contains keywords related to process model. Therefore, S1 contains keywords like software maintenance and software support. S2 contains keywords including outsourcing, global outsourcing, distributed outsourcing, off shore outsourcing, third party outsourcing and on shore outsourcing. Similarly, S3 contains keywords like process, process model, activities, practices, practices and taxonomy. In fourth activity, we created different search strings by linking and concatenating S1, S2, S3 with AND, OR operators. In fifth activity, we selected digital libraries including IEEE, Elsevier, ACM, Wiley, Springer Taylor and Emerald. In the last activity, we searched these digital libraries with the help of search string which we found as the result of fourth activity. The last activity of this searching process produced 429 studies as its result.

2.4 Process of publication selection

First, we defined inclusion and exclusion criteria. The details of inclusion and exclusion criteria are as follows

(i) Inclusion criteria

In order to find out whether a study should be included the following inclusion criteria was used. (1) The publication should be peer reviewed (2) The study should be in English AND (3) The study should describe a research method AND (4) The study should discuss software maintenance outsourcing process or process model or any element related to process model.

(ii) Exclusion criteria.

The exclusion criteria is based on (1) The studies that are written in a language other than English OR (2) The studies that are unable to propose software maintenance outsourcing process model or any related element OR (3) The studies do not have access to full-text (4) or non- peer reviewed studies. Our study selection process consisted of two rounds along with screening procedures. The first-round deals with only titles, abstracts and results of the studies. In the second round we focused the whole text of the studies.

In round 1, the first author reduces 429 total numbers of studies to 120 potentially relevant studies by reading titles and abstracts. To increase the reliability of these results, the second and third authors evaluated the selected studies on the base of titles, abstracts and results. This validation

process reduces number of publication from 120 to 100 potentially relevant studies.

In round 2, the first author read the full text of 100 relevant studies and judged that 50 studies are relevant. To increase the reliability of results of round 2, the second and third authors performed validation process. In this validation

process only those studies were selected which discussed existing frameworks, models, platforms or issues, taxonomy, factor, practices, activities, steps in the context of SMO. Because of this validation process, performed by the second and third authors, the number of included studies reduced to 45 studies. Our results discussed in the later sections are based on those 45 studies.

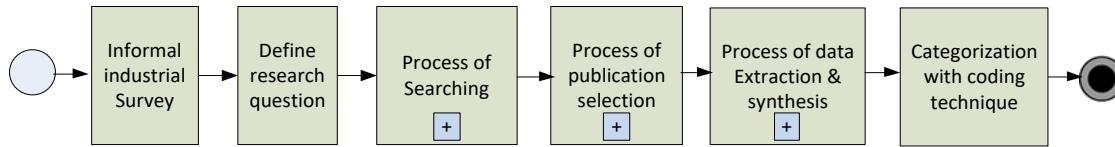


Fig. 1. Research process

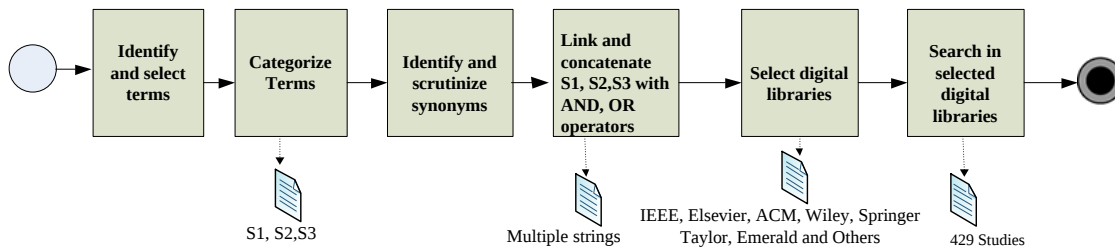


Fig. 2. Process of searching

2.5 Process of data extraction and sythesis

In data extraction and synthesis process, data extraction criteria contain attributes like publication number, digital library, source, title number of citations, method of data analysis, research method, analysis method, method of data collection, outcome and limitation. We finalized 45 studies as a result of this process. To increase the reliability of results, the second and third authors re-screened and evaluated all 45 papers and found that all are relevant as per research question's requirements.

2.6 Categorization with coding technique

In the last activity of research process, we applied coding technique for data categorization [69]. In this technique, we identified the patterns and created the taxonomy of practices by putting the activities serving the same purpose under clusters. We called each cluster as a practice.

3. Results

In this section, we describe our findings. We categorized the selected papers with respect to their research methods and publishers. We answered RQ(s) with the help of findings of our conducted SLR.

Initially we found 429 studies. After continuous screening, 45 studies were finalized for inclusion in this SLR as shown in Table 2. Out of these 45 studies, only 4 studies [S11], [S13], [S31] and [S46] covers major portion of definition of the software process model; other 41 studies

discuss important activity(s) related to software process model. Our primary focus was to elicit the practices, activities, work products and roles from the selected publications.

The selected papers span across 27 years. The oldest paper related to scope of our SLR was published back in 1993 and the latest was published in 2018. As shown in Table 2, eight different publishers published the selected papers. Around half of the studies that is 24 out of 45 (53%) were published by IEEE and Elsevier combined. Table 2, show that 25 out of 45 (55%) studies were published in journals, whereas 20 (44%) studies were published in conference proceedings.

All of papers were categorized based on analysis method used (Table 3) and research method (Table 4). The analysis of Tables (3 and 4) showed that most of the selected studies (68%) used case study as research method. Popular methods for data collection (40%) were questionnaires, interview and documentation. Most of the selected studies (55%) performed qualitative data analysis.

Here, we have addressed the research questions as mentioned in section 2.2. There are three research questions of this study.

RQ1: What are the studies discussing SMO related challenge(s) along with the limitations of these studies with respect to SMO process model?

The study [30] discussed challenges related to the management of application specific knowledge. It presented a collaborative platform to handle this challenge. This platform is a tool named as CollabDev. It claimed to

share specific knowledge to stakeholders involved. This study mentioned roles and activities. The evaluation of this tool is not available as it is in the prototype stage.

Table 2: Final set of papers short-listed in review process

Sr#	Digital Library	Number of publications	References of selected studies	Type of publication	
				Journal	Conference
1	IEEE	16	[19][20][22][23][24][25][26][27][28][29][33][35][55][64][65][66]	-	16
2	Elsevier	8	[10][11][15][50][51][52][53][62]	8	-
3	ACM	6	[30][36][37][48][59][60]	2	4
4	Wiley	4	[12][14][46][63]	4	-
5	Springer	4	[13][16][18][31]	2	-
6	Taylor & Francis	1	[57]	1	-
7	Emerald	2	[58][61]	2	-
8	Others	4	[38][49][54][56]	4	-
Total = 45					

Table 3: Type of data analysis method

Type of data analysis	No. of studies	Study ID
Qualitative	25	S10, S11, S14, S15, S18, S30, S33, S35, S36, S37, S38, S48, S49, S46, S52, S54, S55, S56, S57, S58, S59, S60, S61, S63, S66
Quantitative	12	S16, S19, S22, S23, S24, S25, S27, S29, S31, S50, S51, S53,
Both Quantitative and Qualitative	6	S12, S13, S20, S62, S64, S65,
Not given	2	S28, S26

The study [49] highlighted challenges like priority, time and limited resources. This study also discuss the limitations of existing studies to cope with the latest requirements of outsourced applications.

The study [46] mentions different challenges like change management, quality management, communication management, scope management, knowledge management and risk management. The study also provide some suggestions. The provided suggestions are in abstract form rather than having detail like activities, tasks and methods. The discussed study does not capture any sequence of SMO process. It does not fulfil or satisfy the basic definition and requirements of a software process model [42], [43], [44], [45], [46], [47] and [67].

The study [50] focus on contract related challenges. It suggests exploring formal and psychological contracts from new angles and development of new theories in the domain of IT outsourcing.

The study [52] discuss risks involved in outsourcing. It has presented a framework to assess and evaluate benefits and risks involved in the process of outsourcing. The study suggests that a thorough study is required in the context of small and medium business.

The study [53] focus on the challenges related to supplier selection process. This study presented a supplier selection method which uses a systematic approach to make

calculations more simplified, improved results consistency and reduced human dependency. This method handles intangible and tangible factors as well.

The study [54] highlighted contract related challenges. The study presented contracts as fine-grained specification in an end-to-end business between two organizations. It requires industrial implementation.

The study [55] presented architecture to support the business between two organizations. This study compliments a related study [54].

The study [56] discuss challenges related to purchasing process and effective supplier evaluation. It includes service, price, delivery, quality, supply chain management, process improvement. The author suggested that more work is required on eProcurement.

Table 4: Research Method applied

Research method	No. of studies	Study ID
Case study	17	S14, S15, S18, S19, S20, S22, S23, S24, S36, S38, S28, S31, S51, S59, S60, S65, S66
Literature review	11	S10, S11, S26, S37, S33, S46, S49, S50, S56, S57, S58,
Multimethod 1 (case study and action research)	2	S29, S30,
Multimethod 2 (Literature review+ industrial study or example)	5	S52, S61, S62, S63, S64,
Tertiary study	1	S53,
Narrative	2	S54, S55,
Not identified	7	S12, S13, S16, S25, S27, S35, S48

The study [57] discuss challenges related to contract terms and supplier selection. It discussed assessment of a potential supplier among other suppliers, describing effective service criteria and the evaluation of contract terms. The study needed to be empirically tested or evaluated.

The study [58] discussed challenges related to best supplier selection among all available suppliers. By using concepts of artificial intelligence, Fuzzy AHP can help humans while selecting best supplier. The data set used in this study is very small.

The study [59] discussed challenges related to relationship management between customer and vendor. They suggest customer to emphasize on relationship management with vendor in strategic context. The study suggested to further examined the critical factors related to outsourcing.

The study [61] highlighted challenges related to supplier selection, risk and assessment of vendor's potential performance. The study [62] focus on risks of hiring single or multiple vendor.

The study [63] discusses the changing image of software maintenance from isolated to responsive business in late

90s. It discusses issues and practices of software maintenance in the context of organizational structure.

The study [64] discussed challenges related to management, communication, collaboration process and onshore extensive testing. The scope of study is small, and it is based on a single project.

The study [65] discussed challenges related to the management of technical knowledge and application knowledge in the context of SMO. The limitation of the study is that it focused on a same bank for all cases.

The study [66] focused on activities related to SMO decision. Like general conditions for effective outsourcing decisions, Comparison of vendor deals with in-house solution, identification of core and strategic activities of the organization. This study has limited focus on risk related to outsourcing decision. The study needed to be reviewed according to current SMO business situations.

Table 5: Comparison of Existing Process Models / frameworks With Respect to SMO Process Model
 '√'= Fully covered in paper, 'P'= Partially covered in paper, '-' = Not covered in paper

Reference of papers	Helpful in SMO	SMO Practices	SMO Activities	Roles	Work products	Guidelines
[11]	P	Environmental Resource, PM	√	√	P	P
[31]	P	Risk, SLA, Execution	P	√	√	P
[48]	P	Risk	√	√	P	P
[34]	P	Execution	P	P	-	P
[12]	P	Estimation	√	P	-	P
[30]	P	Knowledge management	P	P	√	P
[38]	P	Handover (framework)	√	P	√	√
[49]	P	Maintenance Management	P	√	P	P
[46]	P	Risk and others	P	P	-	-
[50]	P	Decision, Relationship, Risk,	P	P	-	-
Current study	√	Proposed SMO Process Model	√	√	√	√

RQ2: What are the limitations of existing SMO models?

Table 5 shows limitation of existing models with respect to a comprehensive SMO process mode. We have discussed few existing frameworks / models in detail.

The study [S11] presented initial effort towards a framework dealing issues related to SMO. It classified existing literature and pointed out future work. No validation of framework is provided. The proposed framework does not prescribe hierarchy of SMO process. The study [31] made an attempt to integrate outsourcing activities in an existing methodology for software maintenance (MANTEMA [32]). Although this study contributes towards SMO process model, yet it has some limitations. Its focus is on large organizations only. This methodology is used specifically by a single maintenance (European consultant) firm.

The study [48] presented a framework which only focuses on risk factor during IT outsourcing. The framework is tested through five case studies focusing on complexity of risk, attitude of manager towards risk and relation of risk management with contract design and negotiation as per type of contract. The study is unable to provide a framework or process which has clearly prescribed elements of framework / process model.

The study [49] discussed few approaches regarding Third Party Application Maintenance in the context of outsourcing. The study highlighted that maintenance manager must serve several requests with constraints like priority, time and limited resources. This study claims that current management approaches are not sufficient to cover the needs of third party software maintenance (i.e. SMO) so a comprehensive SMO process model is required

The study [12] presented a model that can help practitioners to understand and control the impact of influencing factors on software maintenance efforts. These factors include organizational climate, attitude of the customer, maintenance team and system baseline. Although the study is useful to estimate maintenance efforts with respect to influence of the factors involved, yet it only focuses only human and organizational factors.

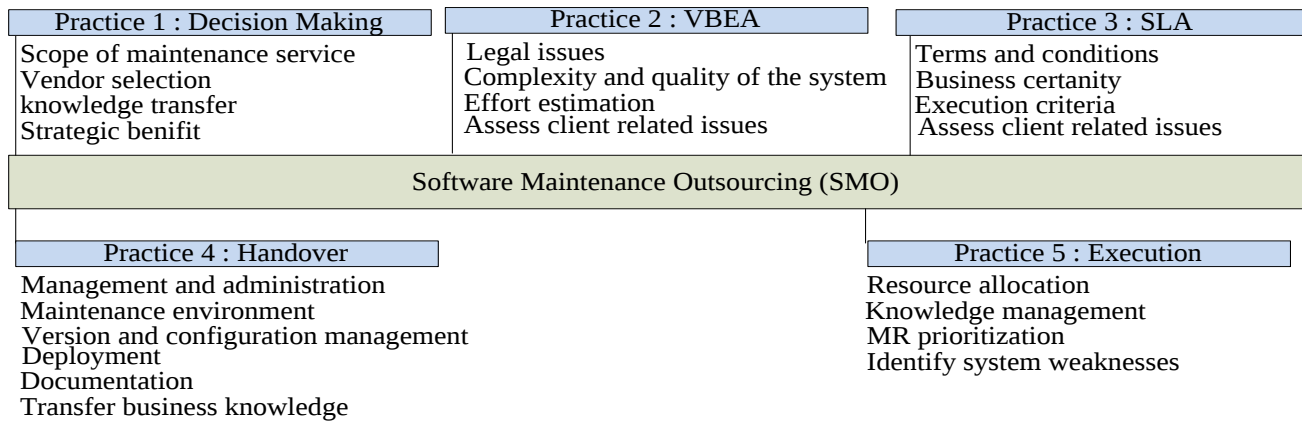


Fig. 3. Proposed SMO Process Model

Table 6 Practice 1: Decision Making (DM)

Activity
DM1.Prepare maintenance proposal focusing strategic plans and benefits [16, 31, 59, 62]
DM2.Decide vendor selection criteria(attributes), number of vendors, their roles [10, 18, 53, 56, 61, 66]
DM3.Identify knowledge gap, backup methods [18]
DM4.Decide scope and type of maintenance to be outsourced [10, 13,14,15,18]
DM5.Identify lower bound of required staffing [25]
DM6.Decide risk analysis and mitigation strategies [10]
DM7. Identify own and vendor business certainty [66]
DM8. Compare in-house maintenance with outsourcing[66]
DM9. Discuss to initiate SMO as pilot project[57]
DM10. Perform risk analysis on wrong vendor selection, cultural mismatch, instability, data privacy, security [10]
Role
Managers as policy makers[10] Executive as decision makers[18] CEO as initiator and Decision maker[13]
Work product
Maintenance strategic plan [10] Central repository[18]
Guidelines
Involve vendor in document review process[10]
Vendor selection criteria include MTTF, experience, staff ,QA, reput, ease of interaction, trainings etc [10,12]
CEO should play strong role in SMO decision making [13]
Use Fuzzy AHP in multi criteria supplier selection [58]
Method
M1. Use multicriteria method to select best vendor [53]
M2. Focus different aspects while deciding best vendor[57]
M3. MAUT method consider all conflicting attributes during best vendor selection [61]

The study [38] presented a framework for handover of software system. Although the study satisfies the basic required elements of a framework, but it has some limitations as per scope of our research. The focus of this study is on only one practice of SMO process that is handover practice rather than whole SMO process. The other limitation of the discussed study is its context. It does not cover offshore context.

RQ3: What practices should be performed during SMO process?

We elicited theory related to software maintenance outsourcing and proposed SMO process model. We elicited the theory after applying *coding technique* on the 45 selected studies [69]. We grouped the activities serving the same purpose under each relevant category. These categories are (1) *Decision Making* (2) *Vendor Business Estimation and Acceptance* (VBE&A) (3) *Service Level Agreement* (SLA) (4) *Handover* (5) *Execution*. We declared each category of activities as a practice. Therefore, our proposed SMO process model consists of five practices as shown in Fig 3. Below we described these practices in detail.

3.1 Practice 1: Decision Making (DM) The goal of *Decision Making practice* is to facilitate stakeholder involved in making decision regarding what to outsource and to whom it should be outsourced. We found ten activities, three roles, two work products, four guidelines and finally three methods (see Table 6).

We found five major areas that should be considered while making decision for outsourcing. These are (i) maintenance scope, (ii) vendor selection (iii) system knowledge transfer (iv) strategic goal for outsourcing.

Scope of maintenance services: We found four studies emphasizing that scope of maintenance services should be defined during decision making [10], [13], [14] and [15]. The scope depends upon the type and need of services provided by

the vendor organization. The scope of maintenance may be limited to only providing corrective maintenance or providing full spectrum of maintenance service including corrective, adaptive, preventive and perfective maintenance.

Vendor selection: We found eight studies that are providing guidance for vendor selection [10], [56], [18], [53], [58], [61], [62] and [66]. There exist multiple criteria

as for vendor selection. The criteria might include the nature of services, price and quality of service delivery etc [10] and [56]. According to [12], vendor selection criteria should include alignment of vendor with client business, ease of interaction, turnover rate and resource availability. It is very important to decide that what will be the role and responsibilities of the vendor [10] and [18]. The scope of maintenance services plays a pivotal role in deciding vendor responsibilities.

There are three studies [53], [57] and [61] describing methods for vendor assessment and selection (see Table 6). The Method 1 suggests of assigning and calculating weights to each criterion [53]. The Method 2 recommends that vendor should be selected by examining its experience, quality of services, tools support and maturity of vendor organization [57]. The Method 3 endorses multi attribute utility approach for decision making with low computational difficulty [61].

Knowledge transfer: One of major challenge of maintenance outsourcing is the system knowledge transfer from client to vendor organization. According to study [18] there should be a synchronized way to transfer the system knowledge. System knowledge is an important asset for any organization, so it is important to keep different backups of this system knowledge [18].

Table 7 Practice 2: Vendor Business Estimation and Acceptance

Activity
BA1. Understand involved legal issues [11, 23]
BA2. Assess quality, complexity of code, documentation, domain, system and deployment [12, 20, 23]
BA3. Estimate cost of software maintenance to be outsourced [12, 22, 23, 25]
BA4. Assess business similarities (among vendor and customer) and stability of client's organization [12, 49]
BA5. Assess customer's expertise in knowledge management and knowledge transfer [12]
BA6. Determine the time zone for which maintenance support is required [23]
BA7. Create a metric to measure the size of individual software artifacts [24]
BA8. Compare the output of this metric to the maintenance plan [24]
Role
Contract establishment manager [55]
Customer as service seeking, Vendor as service provider, Domain specialist [12]
Work product
An influence model [12], Code metrics[19], metrics to evaluate the complexity of a legacy system[20], Maintenance proposal[31]
Guidelines
Use Code metrics to predict maintenance effort [19], use relevant processes for each type of maintenance [22], Effort estimation should be done by a group [23] Use different tools to assess the impact of factors in SMO [12] Take into account all required types of tasks while performing estimating process[61] Use tools for effort estimation [60]

Strategic benefits: One of the main reasons behind SMO is to gain strategic advantages, so study [59] suggests that client organization focus strategic goals that they will achieve by SMO. Therefore, client organization should

compare the offer raised to vendor with in-house maintenance and support options.

It is important for customer to decide on outsourcing software maintenance services to a third party. During this stage several questions discussed like why to outsource, what to outsource, which vendor is best for outsourcing? The activities discuss on making decision about type, scope and vendor for outsourcing maintenance. The activities also discuss about the role, responsibility and expertise of vendor. This practice (DM) emphasized on deciding the method for knowledge transfer, identifying and resolving the knowledge gaps. It is also important to prepare the maintenance proposal during Decision Making practice. Finally, the Decision-Making practice discusses about performance of risk analysis and mitigation strategies.

3.2 Practice 2: Vendor Business Estimation and Acceptance (VBEA): The goal of VBEA practice is to facilitate vendor in estimating and accepting SMO related proposal offered from client side. We found eight activities, three roles, four work products and six guidelines (see Table 7). We found four major areas that should be considered by vendor while estimating and accepting the client's proposal. These are (i) legal issues (ii) Complexity and quality of the system (iii) Effort estimation (iv) Assess client related issues.

Legal issues: The study [11] emphasizes to understand the legal issues involved in SMO.

Complexity and quality of the system: We found three studies emphasizing that complexity and quality of the system should be assessed before accepting the client's proposal [12] [20] and [23]. The client's proposal may range from the maintenance of a simple website to a complex ERP system. The vendor must assess the complexity of system, number of sub-systems, number of interfaces and users etc. The vendor must assess the quality of written code, documents involved etc.

Effort estimation: We found six studies emphasizing on the use of different tools and metrics for effort estimation [19], [22],

Table 8 Practice 3: Service Level Agreement (SLA)

Activities
SLA1. Define roles and responsibilities of vendors [10]
SLA2. Add incentives and penalties (this activity is for client only) [18]
SLA3. Choose team size as per SLA requirements [25]
SLA4. Mention start and end of service contract [27]
SLA5. Compute the availability time of a service [27]
SLA6. Understand applicable laws [26]
SLA7. Mention time zone when service is required, responsiveness, testing standards, release acceptance criteria [26]
SLA8. Define terms and conditions for production support and emergency maintenance [57]
SLA9. Define quality, amount and category of required maintenance [57]
SLA10. Define any criteria for vendor evaluation to an understanding about vendor [57]
SLA11. Define terms to further continue or cancel the SMO process / project [57]
SLA12. Identify business certainty (both client and vendor) [66]
SLA13. Finalize the maintenance contract [31]
SLA14. Define standard or template (acceptable to both client and vendor) to write contract (e.g. complexity of language) and assess risk related to vague SLA [54,10]
Role: Contract manager (from vendor side), Consumer contract manager (from client side) Configuration manager [54]
Work product
Maintenance contract[31]
Guidelines:
Software maintainer should do only customer's required work rather than his own creativity [26]
Before finalizing SLA, customer and vendor should focus on the certainty of their business. There should be business certainty throughout the contract. [66]
In contract writing use easy to understand language [54]

[23], [25], [60] and [61]. The effort estimation depends upon the maintenance request (MR) which can range from the correction of spelling mistake to adding a new feature in the system. So, it will be helpful to use latest tools and metrics for estimation of such efforts to fulfil the client's MR. the vendor should be able to assess lower bound of required maintenance staff to fulfil client's MR.

Assess client related issues: We found two studies [12][49] emphasizing to assess client related issues before accepting the client's proposal. The vendor should assess stability and turnover rate in client's organization, client's familiarity with system and client's expertise to manage and transfer system knowledge.

This VBEA also discuss about the roles, work products and guidelines used in this practice. The businessperson should also focus on other influencing factors, which can affect the business [77].

3.3 Practice 3: Service Level Agreement (SLA): The goal of *Service Level Agreement (SLA)* practice is to facilitate stakeholders involved while writing contract and legal documents. The stakeholder involved can be rewarded or penalties can be imposed as per agreed terms with in SLA. We found fourteen activities, three roles, one work product and three guidelines (see Table 8).

We found three areas that should be considered while establishing service level agreement between client and vendor.

Table 9 Practice 4: Handover (HO)

Activities
HO1. Define management and administration related activities [37]
HO2. Define maintenance environment related activities [37]
HO3. Define version and configuration management related activities [37]
HO4. Define deployment related activities [37]
HO5. Define training, presentations, support simulation related activities [37,51]
HO6. Define documentation management related activities [37]
HO7. Define maintainability management related activities [51]
HO8. Prepare reporting structure [18,65]
HO9. Define suitable method and handover business knowledge from client to vendor [18,65]
Role: Project manager, Developer, Maintainer, Transition team, QA and Deployment team, Documentation manager, SCM manager [38] Vendor Engineer, Subject-matter expert, Client manager [65]
Work product
Taxonomy of handover activities [37] Software System handover framework [38] design document[65]
Guideline
Along with technical and business knowledge the application knowledge should also be consider as dominant knowledge [65]

These are (i) terms and conditions (ii) business certainty (iii) Execution criteria.

Terms and conditions: We found five studies emphasizing on mentioning terms, conditions and different parameters involved in SMO related SLA [10], [18], [25], [26] and [27]. These include start and end time of contract, roles and responsibilities, incentives and penalties, team size and required experience, service availability time, testing standards and acceptance criteria etc.

Business certainty: The business certainty is important throughout the contract life. The study [66] emphasize that both client and vendor should know about the stability and certainty conditions of each other's businesses. The study [74] focus on risks related to contract (SLA) in SMO context.

Execution Criteria: The study [57] emphasizes to define such criteria with terms and conditions which clearly direct to further continue or cancel SMO project.

The practice SLA identifies different roles like contract manager and configuration manager. This practice also identifies a method used for contract [55]. This method provides guidance from contract establishment to performing the post analysis.

3.4 Practice 4: Handover (HO) The goal of *Handover (HO)* practice is to facilitate stakeholders involved while transferring software, data, knowledge etc during SMO process. This practice consists of nine activities, ten roles, three work products and one guideline (see Table 9).

We found seven major areas related to handover practice of SMO. These are (i) Management and Administration (ii) Maintenance environment (iii) Version and configuration

(iv) Deployment (v) Transfer business knowledge Management and Administration (ii) Maintenance environment (iii) Version and configuration management (iv) Deployment (v) Training (vi) Documentation (vii) Maintainability management.

Table 10 Practice 5: Execution

Activity
EX1. Define resource allocation as per SLA constraints [29]
EX2. Establish mechanism to acquire software specific knowledge [30]
EX3. Define mechanism for availability of knowledge to the concerned stakeholders at all the time [30]
EX4. Initiate modularity analysis of the code [30]
EX5. Establish strong, reliable collaboration among stakeholders [30]
EX6. Decide which type of maintenance should apply on customer received request [31]
EX7. Define requirements prioritization process [63]
EX8. Establish staff hiring criteria as per client's requirements [63]
EX9. Identify weaknesses of the system [28]
EX10. Map MR with agreed timeline [35]
EX11. Define mechanism for role identification, duplication and impact of MR, proactive risk approach, risks in knowledge sharing, user requirement satisfaction [15,33,35,51]
EX12. Define key performance indicator (KPIs) to capture, codify, store and distribute knowledge [52]
Role
Vendor who servers the client [29]
Work product
Resource allocation plan [29]
Guideline
Use software Cybernetics to handle resource allocation issue [29] Use tools for knowledge management [30]

The study [71] alerts the stakeholders involved about the risk involved during handover (transition) practice in offshore outsourcing.

3.5 Practice 5: Execution (Ex): The goal of *Execution (Ex)* practice is to facilitate stakeholders involved while executing SMO process. This practice consists of twelve activities, one role, one work product and finally two guidelines (see Table 10). We found three major areas that should be considered during the execution practice of SMO process. These are (i) resource allocation (ii) MR prioritization (iii) Identification of system weaknesses. The study [73] focus supplier related risks in SMO context.

Resource allocation: The study [29] emphasizes to cost effectively allocate resources for MR as per SLA constraints.

Knowledge Management: The study [30] emphasizes on system knowledge. It suggests establishing a mechanism to acquire software specific knowledge from client's side and it should be available all the time to all the stakeholders involved. The latest study [71] emphasizes on the risk attached with knowledge and supplier specific risks [72] in the context of SMO.

MR prioritization: The study [63] focuses on the establishment of a process to prioritize the client's MR.

Identify system weaknesses: The study [28] suggests the use of latest tools to identify the weaknesses of the system.

This practice of handover also identifies role, work product and guidelines. The resource allocation plan is an important work product and should be prepared effectively to fulfill SLA constraints.

4. Conclusion

This paper presents a preliminary version of SMO Process Model / Framework which consists of six practices. We elicited the model by performing a systematic review of literature with focus on challenges and limitation of exiting process models in the context of SMO. We followed SLR protocol defined by Kitchenham [41].

1- We inferred that there are six major area that should be taken into account by any organization involved in SMO. These areas are (i) Decision Making (ii) Vendor Business Estimation and Acceptance (VBEA) (iii) Service Level Agreement (SLA) (iv) Handover (HO) (v) Execution.

- The major challenges for SMO *decision making* are deciding about the scope of maintenance, vendor selection and method of knowledge transfer.
- Similarly, it is important that the vendor organization should consider legal issues, complexity and quality of the outsourced system and effort estimation for providing outsourcing service before accepting the proposal from client side.
- We also observed that *service level agreement* plays an important in facilitating vendor and client organizations for writing contract. Both parties should agree on term and conditions for resolution of future conflicts.
- The results of our study showed that *handover* is a critical area with respect to SMO. This is practice where system is transferred from client organization to vendor organization. We found that vendor organizations may face many challenges during maintenance provision after handover. These challenges include resource allocation, knowledge management and modification request prioritization.
- We observed that stakeholders involved face different issues during Execution of SMO process like resource allocation, knowledge management and prioritization.
- Finally, we observed that the parties involved in SMO should identify and mitigate risks throughout the SMO process in every practice.

2- We observed that SMO is a complex process spanning across different practices. However, there exists no publication dealing with all significant practices and describing basic elements of a process like activities, roles, work products and like. In literature, there exists no study which can provide us a comprehensive SMO process model or have tried to systematically define the SMO

process. Thus, this paper is a novel contribution to define SMO process in a systematic way in the form of SMO process model.

3- We observed that SMO span across the early stages when client initiate its proposal to outsource its maintenance services till the provision of his required maintenance service.

5. Future Work

In this study, we found five SMO related practices, arranged these practices in a logical order and proposed a preliminary version of SMO Process Model / Framework. The framework presented in this paper, requires industrial feedback to examine the gaps between theory and actual practice. The validation of all five practices of this proposed SMO Framework or any individual practice through some statistical, machine learning or data mining technique would be praiseworthy. These validations of elicited theory will help us in evaluating and evolving the SMO process model and ultimately it will serve both industry and academia.

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