Software Maintenance Outsourcing (Systematic Literature Review)

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Abstract— **Multiple papers elaborated the concept of software project outsourcing and maintenance to help us about to know that whether it's a good approach or not, what are the pros and cons of outsourcing the maintenance, what it effect on the software development company. This paper will help to get generic overview of software maintenance outsourcing, pros and cons and the concluded result whether this technique is good or not, whether it have benefits or lose.**

I. BACKGROUND

Software Maintenance Outsourcing is becoming the popular activity. Most High level organizations are trying to outsource their projects maintenance to other organizations that increase the organizations cost effectiveness and efficiency. There are multiple research and review papers are available that discuss about the Outsourcing the Software Projects.

[1] It discuss that why only the software maintenance outsourcing is useful, how much and what are the benefits of the outsourcing the Software Maintenance. How can we keep track and how we access the outsourcing vender organization?

[2] He describe the issues that occur during outsourcing and also the strategies that an organization adopt and how the organization make the maintenance reliable and cost effective.

[3] They focusses and discussed the client-vender organizations relationships and provide a way to make trust worthy relationship between client and vender of the outsourced project. Also described the factors that are critical to trust in the outsourcing relationships.

[4] A complete research paper about the types of the software evolutions and software Maintenance. Software evolution management, software maintenance management, maintainer activities, maintenance terminology, evolution terminology, software support, empirical studies are the main points that are being elaborated in detail in that research papers.

[5] Paper discussed the implication of policies of the software outsourcing and development that are required during outsourcing time between outsourcer and vender organization.

[6] It describes that which type of organizations and firms choose outsourcing, why they choose and what the benefits are. The CEO Involvement in outsourcing, activities of outsourcing, Methodology is described for outsourcing process.

[7] However all the small software projects are easy to maintain but the problems occur in large packaged application software maintenance, this paper described to manage the maintenance of the large projects. A complete overview of cost effectiveness and benefits of the incidence of maintenance. They proposed a software maintenance research framework that I quoted below with reference.

Figure No 1 Software Maintenance Research Framework

The main purpose of this project they defined that to highlight the important dimensions that are affective to maintenance scenarios.
A complete research work was proposed by them that is really helpful about software maintenance.

[8] They describe the Issue in Global Software Outsourcing and also the managing the cross culture issue in Global Software Outsourcing, they proposed the strategic choice to choose which type of projects to outsource, managing the relationship of the client vender organizations and staffing issues. They choose a way to train the employees about all the aspects to handle the issues.

[9] Trust is the most important factor during any type of sharing. They discussed the trust in software outsourcing relationships. They investigate some of the Indian software companies to check out the trust worthiness and experience gained of outsourcing. Mostly companies were of CMM registered companies and have CMM level 4 and 5.

[10] They investigate the difficulties in outsourcing relationships. They highlighted the infrastructure problems, technical compatibility, distances and cultural differences of the client vender organizations and proposed the methods to deal with them.

"Clients and software developers need to move their global outsourcing relationships up the value chain to reap greater benefits. Yet such moves bring costs and risks. The authors investigate the strategies that differentiate successful and unsuccessful value chain moves."[11].

II. INTRODUCTION

Outsourcing— A process in which an organization do not have much resources to complete a particular phase or a complete project by itself because of lack of expertise on such a technology or they do not have such employees to complete that particular task, then the organization contract with the vender organization that have all the particular expertise to complete that task and the organization hire that vender organization to complete that task. Once the organization outsource the particular task then the vender company take all the responsibility of carrying out the organizations assets and maintain that task.

Why an Organization Choose Outsourcing— there are lots of reasons and factors on which an organization choose outsourcing. Following are the most common factors

Lack of expert employees: When the organization have a task that they can't execute because of less or non-experienced person.

Cheap Employees: Most of the organization have a task that must be complete with the perfection factors, means there are no such risks that the task fails to complete, then that organization can't rely on those labors who have less salary, because it's a human nature that human don't take much attention on the work here he get less reward in return.

Other Critical Business Processes: In the organization there are more than one process executes simultaneously. Organization have to focus on for example two process at a time, then they don't have much time and resources to complete both processes then they outsource one of the process to vender organization and then they completely focus on one of the process completely.

Cost Budgeting: when an organization have to get maximum budget on any project then they try to outsource a project on less cost to vender organization. Vender organization complete that project in less cost and the owner organization get some profit.

Outsourcing in Software Industry— there are lots of importance in the field of Computer science and IT industries of Outsourcing. Due to Emerging and new Technologies such software industries often outsource their projects to other software industries and perform their tasks. Software Development process executes in SDLC steps that are

- Analysis
- Design
- Implementation
- Testing
- Maintenance

Mostly industries outsource a complete project but some industries only outsource the project for any of the above development phase. Further paper will focus on the outsourcing the software only for maintenance.

Software Maintenance— software maintenance is the SDLC phase that is, the assurance of the performance of those activities of the software, which are essential and required to keep a software operational and responsive after being accepted.

The major tasks of software maintenance is to check whether a software is executing correctly without errors and exceptions, or any client need some changes due to change in requirements.

Outsourcing only the Software Maintenance Phase— Day by day increase of burden of software maintenance of multiple projects can effect on quality of the small level software industries. Hiring more and more employees for maintenance can affect the organizations budgeting plan and leads to lose, hence they outsource their projects to other industries to minimize their burden and maintain their quality and organizational strategic plans.

Software Maintenance Issues and Problems— the crucial phase of maintenance becomes more complicated due the fact that, sometimes, most of software used for the software product are outsourced as well.

One of the main risks to product quality associated with introducing outsourcing organizations is the future maintenance difficulties mainly due to low quality software and/or poor or incomplete documentation of components developed by outsourcing organizations. This may results in higher maintenance costs to the contractor.

Another complication in maintenance arises due to the fact that the maintenance services might be supplied by more than one contractors; and each of these bodies take very limited responsibilities.

As the software maintenance is usually not considered to be enterprise's core competency, outsourcing allows management to focus its scarce resources on those activities that are truly core to the business. Outsourcing maintenance may not the

right answer for every maintenance situation due to high risk involved.

Maintenance of a product developed heavily from outsourced components is very complicated issue. In maintenance issues for COTS-Based systems were addressed.

Problems and Issues in Outsourcing— the major and most crucial Issue in outsourcing is that the organization compromise the confidentiality of the projects to vender organization. Such critical software projects need confidentiality that have to secure. If the vender organization break the confidentiality, it can make some most critical lose to the outsourcer organization.

Another problem is that the vender organization must be able to complete the outsourced project with all their expertise, also on time and if they don't do the work properly, it can lead the project to failure.

III. RESEARCH METHODOLOGY

We have used systematic literature review process in our research. SLR is a way of discovering, computing and inspecting published study to examine a specific research question. A Systematic review different from ordinary survey. They have different kind of procedure then ordinary review papers. In finding, assessing and outlining all available resources on specific research question, a SLR may provide a greater deal of authenticity.

A) Research Strategy: Search engines performed search automatically of specific conferences, journals and proceedings since 2005. Each paper relevant to the research question is reviewed by two researchers (Farzan Javed and Faizan Rasul). In our search strategy we include conceptual studies and research methods. Only the papers which are written in English are selected by the researchers.

1. IEEE Xplore:

http://ieeexplore.ieee.org/Xplore
2. ACM Library:
http://portal.acm.org
3. Elsevier:
http://elsevier.com

B) Search Terms: Search terms are built in following manner; First, we identified the keywords for each research questions. Second, we identified the synonyms for those keywords. Third, we joined the synonyms and keywords with operator OR & AND. First Step: Keywords identification "Software, Maintenance, outsourcing" Second Step: Synonyms identification "Maintained, outsourced, IT, Vender" Third Step: Joining or Keywords and Synonyms of those keywords e.g. 'Software OR IT' AND Software OR Vender.

C) Selection Criteria: By using above mentioned search strategy we found a large number of research articles. An inclusion criterion identifies that which papers are to be used in the research study. And an exclusion criterion identifies that which papers should be excluded from the research study and which are irrelevant.

Inclusion criteria:
- Theoretical concepts of software maintenance outsourcing.
- Software maintenance in context of outsourcing
- Software outsourcing in context of maintenance.
- Research paper which directly describing the research topic.

Exclusion criteria:
Some of the material has been excluded due to following issues:
- Material was addressing Software Maintenance but not in context of outsourcing.

- Material was focused on Software outsourcing but not in context of maintenance.
- Material was on Software outsourcing but not in context of IT.

D) Process of Selection:
- Process of selection of papers described blow;
- First, Researchers search the relevant research papers based on their titles.
- Papers were evaluated based on agreements and disagreements of the researchers.
- Second, Papers were examined by reading their abstracts. By which final list of papers is created.

Paper Resource	Total Papers Found	Relevant Papers Found	Papers Selected(Final)
ACM Library	12	8	1
IEEE Xplore	24	13	8
Elsevier	06	3	2

IV. CONCLUSION

Outsourcing is a process that is effective way to manage the budgets and efficiency of the project. It can help an organization to maintain its own quality and reliability. An organization can take so much benefits by outsourcing process. And organization that don't have skills and new technology expertise can outsource their projects and can get their work complete by other organization with maximum utility and minimum cost. This savings of the project can be helpful for the organization infrastructure development and future works.

Every beneficial and helpful thing have also some drawbacks and issue. Also outsourcing have its own issue because one organization completely takeover the project confidentiality to vender organizations hand. Hence there is a simple solution to manage this issue that, there must be good relationships between client and vender organizations. A trust factor should present in both organization that the vender will never expose confidentiality of the outsourced projects.

Only outsourcing the maintenance phase of the project is most useful and helpful to organization. Because and organization develop a project with all the rule and techniques they have and apply their own standards of development like CMMI certified software houses. They have rules and regulations of their organizations. They develop project with their standards and then deploy, and they now that software is a good software because it have developed with good process. After deployment of the project only maintenance phase left. That organization can hire a vender to maintain that project.

There should a process and agreements between organizations to handle outsourced projects.

Agreement: There must be an agreement document signed between organizations, not to expose the confidentiality of the project.

Keep Track: there must be a way to track out the vender organization.

Trust: only hire those organizations for outsourcing who have market value and experience and have trust in the market. It will help to prevent the fraudulent of the organization.

Monitoring and Control: For maintaining the quality of the project, there should be proper process execute to monitor the maintenance performed by the vender organization. Monitoring

will help to check out that the vender organization is maintaining well or not.

V. ACKNOWLEDGEMENTS

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