Implication of Systematic Review for Prioritization of Factors Affecting Process Improvement

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Abstract: Process Improvement is one of the most important issues in growing organizations. Many organizations use different tools and apply personalized strategies to improve their processes but they are not sure about the consequences of all such activities and their efforts. The changed or improved processes most of the time bring unexpected results and sometimes making the efforts futile. In this document, we identify the top ten factors with the help of a light weight systematic review. In this review, the factors are collected and prioritized according to their importance and effectiveness as discussed and used by both Industry and Academia.
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1. INTRODUCTION

This document shows an execution of a light weight systematic review regarding the factors affecting process improvement activities during change. The review is strongly based on inclusion and exclusion criteria that strengthen the purity and compactness of this research. Different electronic archives have been explored (1997-2007) to identify the previous research and industrial reports to make a stronger platform for this review. In the end of this review, the factors are clearly identified and prioritized to make a conclusion more compact and to the point.

2. CONDUCTION OF REVIEW

2.1. Review Planning and Need

Planning is the first part of systematic review. A good planning provides a stronger platform to the research. A proper planning is also playing a vital role in this systematic review. Before performing systematic review, it is very important to inquire about the previous research that has been done in that particular area so that the duplication of the research can be avoided and the usability of the review can be enhanced. Moreover, this activity makes the review unique in nature and increases the effectiveness to get better and useful results. This systematic review is planned to identify and prioritize the factors affecting process improvement. There can be multiple reasons for performing this systematic review but in this research a special attention shall be given to the following point:

- Collection, Identification and Prioritization of ten most important factors found and discussed is Industry and in Academia.

2.2. Development of Review Protocol

The review protocol helps the review from being diverted and keeps the research on track. It also reduces the possibility to involve the biased behavior from researcher's side. It also helps the researcher to be neutral to get the positive and effective results. Without protocol, a researcher may select or ignore many important studies that can be helpful in attaining the correct results. Protocol always keeps the research as target oriented rather than general because it provides a track to perform a review. It initiates with the research question(s), includes the search strategy so that readers must know that how search is being done by the researcher. Targets are set to make the research more effective, correct and efficient. These small targets may also provide better chances to achieve the final goal. Some of the main steps are also included as a part of this review as discussed in [2] which make this review detailed in nature.

Search Strategy:

The search strategy is based on the key words, which were used in identifying the change and corresponding factors. Many databases (as shown in the tables below) were used in order to find the targeted literature for this review.

Search Terms:

Search terms are very important in searching the required literature. The outcomes of the queries depend upon the words and terms used for search. Special attention is given in specifying the search terms. Search terms are used in combination of 'AND' and 'OR' words for detailed outcomes.

Search Resources:

Multiple resources i.e. ELIN (BTH), ACM, IEEE, INSPEC, GOOGLE, SCIENCE DIRECT are considered in order to get the required literature. The reason behind it and using multiple databases is to get the potential and useful literature for this systematic review. By doing so, we can draw better conclusion based on the literature collected from these databases.

Study selection criteria:

The main motivation and effort is to answer the question(s) of systematic review so that useful results can be gotten.

Data extraction strategy:

It is the process of extracting material from the collected literature or primary study to be included. To be on the neutral side, tables and forms are developed to keep our self focused in data extraction activity. Data extraction forms contain the general information about the literature i.e. author, title, year, paper type etc.

Data synthesis:

It collects and summarizes the literature of primary study that is used in this systematic review. Tables can be drawn that can provide us information about primary studies.

Questions Type:

These are the questions that are addressed in this systematic review. They serve as a main research question(s) to be addressed. The research questions are based upon the on going research in this systematic review.

- Identifying factors affecting software process improvement during change.
- Prioritizing the factors to make the improvement effective and efficient. Through prioritization, improvement activities and sound change can be better managed.

2.3. Systematic Review Conduction

Personal liking or disliking of research papers or any specific literature is always avoided. When performing research under systematic review, we always follow a defined, documented and strict procedures based on the defined protocols as discussed in [2]. All steps are performed according to the defined procedures so that the review can be managed and usability of systematic review can be enhanced. All the available literature is collected before starting systematic review so that the required information can be retrieved.

Literature is collected from six different sources. It is studied, evaluated and then compared to other studies so that some useful results can be generated. It is the second important stage in the systematic review. At this level, the whole review is conducted based on many small activities and steps. Primary studies to be included, evaluation, assessment of authenticated research and all the other necessary procedures are executed as mentioned in [2], [3], [4],[5].

2.4. Identification of Research

Identification of new research is a continuous process as we go further; we find vast variety of research literatures. There are many sources available currently i.e. online databases, electronic database in the library, books available in library and websites. The previous researches including both industry and academia are searched and evaluated from 1997 to 2007. The main motivation is to find maximum possible literature available related to our research area. The queries are written with various combinations of 'OR' and 'AND' so that maximum possible results can be retrieved. By doing so, the mistakes in searching material can be reduced to make our query results more reliable and effective. All types of studies are considered while identifying the research i.e. research papers, journals, industrial reports etc. The search is also conducted by adding and removing 's' with the terms in order to make our self sure about the availability of research in databases. All types of studies are reviewed for inclusion or exclusion without favoring any specific study. The journals have been looked separately from the research papers in order to make identification more thorough and to produce satisfactory results. To avoid the mistakes, title, abstract, introduction and conclusion are always read before selecting the literature. By doing so, we can avoid repetition of studies and also select the most appropriate studies for our review.

2.5. Selection of Studies

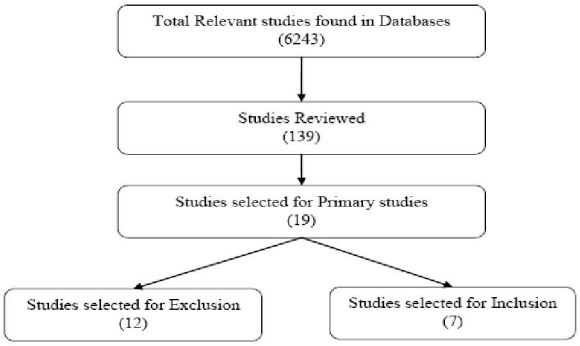
After the search activity, suitable literature for the review is selected and irrelevant material is discarded based on inclusion and exclusion criteria. The relevant material is then analyzed to achieve the required results. It is also important to document the study selection for both i.e. inclusion and exclusion [5]. It reflects the unbiased behavior of the selector. The details regarding the selection of studies are shown to understand the inclusion and exclusion of the primary studies from various databases.

Study selected from 1997-2007

DATABASE	STUDIES FOUND	STUDIES REVIEWED
INSPEC	3011	34
ACM Digital Library	200	17
IEEE Xplore	2	2
GOOGLE	1930	47
ELIN (BTH)	1054	27
SCIENCE-DIRECT	46	12
TOTAL	6243	139

By using different databases as mentioned above, the following figures are found and reviewed. The studies found during the search have been identified with different set of queries. In INSPEC 34 studies are reviewed, in ACM 17 studies are reviewed, in IEEE 2 studies are reviewed, in Google 47 studies are reviewed, in SCIENCE-DIRECT 12 studies are reviewed, and in ELIN (BTH) 27 studies are reviewed to get the required literature for this systematic review so that useful and productive results can be found.

Flow Diagram of Study Selection Process



2.6. Quality Assessment

Quality assessment is also very important aspect after selecting the studies for review. Both internal and external quality assessments are covered as internal describes the ways for performing research and external describes the results or outcomes [5]. The suitable studies are selected which can provide us the correct and more useful information for our review. Moreover, the less useful studies are rejected especially through exclusion criteria. The studies selected for review had the least possible threshold as far as quality is concerned. Such factors have been given a good consideration while performing the quality assessment. The quality assessment is also judged by keeping in mind the questions below:

- Is primary study relevant to research that is being done by the researcher?
- Are the studies providing enough information to draw the results that will be beneficial for this systematic review?
- Is the change identifying and reflecting some factors that are necessary to deal with in the process improvement?
- Are all studies selected without any favor of the selector in order to make this review neutral and positive?
- Are all selected studies giving any productive results when combined and reviewed all together?
- Are studies conducted according to the predefined pattern?
- Has biased behavior not used by the reviewer?

Table 1.

Primary Study	Research Type	Study Type	Study Duration
P1	Case study	Industrial	1997-2001
P2	Action research	Industrial	Not mentioned
P3	Experiment + Case study	Industrial	Not mentioned
P4	Case study	Academia	Not mentioned
P5	Survey	Industrial	Not mentioned
P6	Case study+ survey	Industrial+ Academia	Not mentioned
P7	Case study	Industrial+ Academia	Not mentioned

The table below shows the primary studies along with the participants' type, participants' level and number of participants involved in the study. Professionals are involved in primary studies so that some useful results can be generated. Numbers of participants are mentioned in the studies (P3, P7) and rests of the studies do not mention any information regarding the number of participants involved.

Table 2

Primary study	Participants' type (professional/student)	Participant's level	Number of Participants
P1	Professional	Managerial/Experienced	Not mentioned
P2	Professional	Experienced	Not mentioned
P3	Professional	Experienced	56
P4	Professional	Experienced	Not mentioned
P5	Professional	Experienced	Not mentioned
P6	Professional	Experienced	Not mentioned
P7	Professional	Experienced	13 companies & 200 practitioners

2.7. Quality Assessments

The table 3 below shows the primary studies along with the study design, data collection approach, validity threats and measures to avoid biases. Data collection provides us the information about the involvement/collection of study material by the actual researcher of the literature. Either the researcher has collected the information by involving himself in the research or has collected the data from industrial reports. Validity threats show that if any threat has been shown in the study and is there any mechanism shown to avoid such threats and biases.

Table 3

Primary Study (P)	Study design	Sample/Data collection approach	Validity threats and biases	Measures to avoid biases
P1	Appropriate	Self involvement	Not reported	No proper information
P2	Appropriate	Self involvement	Not reported	No proper information
P3	Appropriate	Previous reports and case studies	Not reported	No proper information
P4	Appropriate	Previous studies	Not reported	No proper information
P5	Appropriate	Previous studies	Not reported	Partial
P6	Appropriate	Survey and previous reports	Not reported	Partial
P7	Appropriate	Previous reports	Not reported	Partial

The table 4 given below shows the data analysis, statistics used and outcome assessment of

the primary studies. The table shows that if any data analysis performed in the selected study and statistics used to measure the intensity of studies. Moreover, what can be the outcome assessment of those analysis and statistics used?

Table 4.

Primary Study	Data Analysis	Statistics used	Outcome assessment
P1	None	None	Not performed
P2	None	None	Not performed
P3	None	None	Not performed
P4	None	None	Not performed
P5	Partial	Chi Square/frequency distribution	Performed
P6	Partial	frequency distribution	Partially performed
P7	Partial	frequency distribution	Partially performed

2.8. Availability of Primary studies:

The table is given below shows the selection of primary studies from available databases. The table gives the information regarding the availability of primary studies in different databases. The primary studies available in multiple databases ensure the importance of literature and material available in them.

Primary studies	ACM	ELIN@BTH	Google	IEEE	INSPEC	Science Direct
P1	√	√		√		
P2		√				√
P3	√	√	√		√	
P4		√		√		
P5		√	√			
P6	√	√				√
P7		√	√		√	√

2.9. Prioritization of Factors:

The table given below shows the factors affecting the software process improvement while having the change. These are the factors found in the primary studies and after identification, these factors have been given priority on the basis of importance given by the researcher based on their experiences and research. These prioritized factors can provide a solid background to the reader in understanding the importance of such factors during process improvement.

1. Vision: Understanding aim, objectives and the ways to reach the final destination.
2. Lack of Communication: Vertical and horizontal communications among management, change leader, employees and organizational departments must occur during the improvement activities so that every one must know the current states of processes.
3. Lack of management skills: Lack of management skills during process initiation, execution and implementation can also alter the results. It is very important to manage all such activities in proper time.
4. Management's commitment & support: Proper support, dedication, commitment, and serious attitude of management is required to make the improvement effective, rapid and useful for organization.
5. Leader/Change agent's skill: Skills of higher management and of leader to accommodate and adapt the situation according to the change occurring during improvement. And to find better ways to handle the improvement activities.
6. Staff's involvement and participation: It shows that how much staff is involved in process improvement while having change. Moreover, the participation of employees also proves to be beneficial during process improvement.
7. Unfreezing Organization: To soften the current ongoing processes so that new ways of improvement can be introduced and executed.
8. Change Management: To take proper care of the change being occurred inside the organization.
9. Monitor and Analyze improvement: To monitor the whole execution and analyze the improvement activities so that some positive results can be estimated.
10. SPI understanding: It is important to understand the steps involved in executing the process improvement so that current processes can be identified, evaluated and improved with proper understanding and expertise.

Table P.

Factor	*Priority*	*Supporting Primary Study*
Clear Vision	1	P1, P2,P4, P5, P6,
Lack of Communication	2	P2, P3, P5, P6, P7
Lack of Management skills	3	P1, P2, P5, P6, P7
Management's Commitment	4	P1, P3, P5, P6
Leader/Change agent's skills	5	P3, P5,P6, P7
Staff's involvement and participation	6	P3, P5, P6, P7
Unfreezing Organization	7	P3, P5, P6,
Change management (processes)	8	P1, P2, P6,
Monitor and Analyze improvement	9	P1, P5,
SPI understanding	10	P5, P6,

3. FINDINGS OF THE REVIEW

This part shows the productivity, findings and effectiveness of systematic review. Strong interpretation of results supports the strong conduction of the review. Interpretation of results is done in a meaningful and simplest way so that readers can get maximum possible information from this review.

Many researchers and organizations discuss such factors based upon their own experiences but there is no single point of mutual agreement for preeminence of such factors. Organizations always prefer and consider those factors, which they feel to be important for improvement rather than realizing the actual factors affecting the process improvement activity. This systematic review identifies and prioritizes such factors in chronological order based upon the factors discussed and used in industry and in academia. These identified factors if followed properly can easily provide effective results to the organizations.

4. CONCLUSION

A successful execution of a systematic review is performed which brings ten main factors in the end, which really help the software process improvement activities especially when an organization is planning for a smooth and successful vertical transitional change. The results and evidences have been clearly specified in the form of tables and diagrams to create easiness for the reader and to get beneficial result from this research.

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