

Competencies of a Requirement Engineer - Systematic Literature Review Protocol

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Abstract- Requirement Engineering (RE) is a core activity of software engineering that guarantees successful project delivery within time and budget. It needs to be considered with respect to the competencies and skills of RE to effectively execute the RE processes and individual sustainability of requirement engineers. Several skill and competency frameworks are proposed and remember in various fields, however there is no competency framework for software requirement engineers. In this research work a systematic literature review protocol is presented as an initial step to design the framework that constitutes the competencies required for RE. Focusing on the competencies and skills of a requirement engineer will help to effectively perform requirement-engineering tasks that will eventually lead to the success of a project.

Index Terms-- Requirement Engineering, Requirement Engineer Competencies, Requirement Engineer Skills, Software Engineering

I. INTRODUCTION

Change in environment is dramatic while conducting requirement engineering processes in the context of software engineering [1]. At the era of 1960 as well as 1970, there have strong links between design problem and science as well as mathematics, while focused on one reality belief that is quantifiable and essentially remain the same for all. To bridge the gap between user needs and technological capabilities there is no generic technique or method [2, 4]. To build software only this was the era [3]. There after requirement engineering has flourished from 1990 to 2000 to define functionalities [3].

Software Engineering Body of Knowledge (SWEBOK) [5], has elaborated the tasks as well as the skills which are related to requirements in the field of software engineering. The university institutions are in practice to teach the requirement engineering courses in alignment with the guidelines of SWEBOK. Likewise, the textbooks (e.g. [6]) in requirement engineering, addressing all the necessary tasks. However, in industry the requirement engineering practitioners are in practice to create their own requirement engineering related tasks as well as skills. These tasks and skills reflect their specific knowledge as well as understandability of requirement engineering roles and the specific business demands as well. Empirical studies that are collectively concluding on requirement engineer profession in different regions as well as countries [7, 8, 9, 10], shows that there is a gap between textbook and industrial practices of a requirement engineer.

To streamline the practices of a requirement engineer he/she must have general skills set or competencies with respect to requirement engineering to perform their requirement engineering activities successfully and to sustain in the industry [20].

The limited research about the competencies of a requirement engineer motivated us for the conduct of this study. This study has two main purposes. The one is to identify the beneficial competencies of the requirement engineer and the other one is what must be the essential competencies that a requirement engineer must have to become a successful requirement engineer.

This study will provide guidance about the requirement engineer competencies. How it will impact the process of requirement engineering. How these competencies will overcome the challenges that comes to a requirement engineer, and how the conflicting issue will be resolved with the help of a specific competence. To find out the solution to these problems this study will focus on collecting information with respect to requirement engineer competencies. In this regard a systematic literature review is the suitable technique to notify, gather as well as document the required information via literature. There have been a lot of work performed in the field of requirement engineering but still there is a gap regarding comprehensive systematic literature review about the competencies of a requirement engineer that may possess by the requirement engineer to perform their requirement engineering tasks



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accurately and efficiently. This paper aims to gather significant information regarding the competencies of a requirement engineer in a systematic way. That is why this study is genuine with respect to the competencies of requirement engineer and its impact on the requirement engineering process. There have a comprehensive procedure about the SLR of competencies of a requirement engineer, such that having recognize, evaluate and organize those competencies and their impact for the aforementioned topic. This will help to direct future research in the context of requirement engineer competencies in software engineering.

This article is modularized as section number one is about the brief introduction of the topic and why SLR is in need in this context. Section two tells the background details. The third section includes the protocol about SLR. Section number four includes conclusion as well as future directions.

II. BACKGROUND

Software engineering aims to develop quality software products, having the capability to accomplish the user known and unknown need. To achieve the user need via software products there have to be an uninterrupted insight as well as alteration of the software work product. Amongst them there are requirement documentation, design as well as source code etc. in the whole process of software engineering.

In software engineering, the role of requirement engineering is much critical, because this is the phase where requirements are to be collected while consulting with various stakeholders and then put down the need of those stakeholder, such that what they want from the software under development. Requirement engineering process comprise of activities like elicitation, analysis, documentation, validation and management of requirements [11, 12]. Amongst the challenges of software engineering, the requirement engineering is considered as the most significant because of its impact on each phase of the software development life cycle [13]. In the context of the requirement documentation, requirement engineers have a key role. To produce quality requirements, requirement engineers must possess the essential skills and competencies to elicit quality requirements and document them.

The term skills and competency are sometimes used interchangeably, however there is a difference between them. Skill basically reflects a learnable ability that is required while performing a given task. While competency is not just skill and knowledge, it has the capabilities to meet complex demands via incorporating as well as mobilizing psychosocial resources, which further incorporate attitudes as well as skills in a specific circumstances/context [14]. In this article the term competencies is used rather than skills which reflect the perspective that skill and knowledge are entwined as suggested by Pellegrino and Hilton [15], which are based at the terminologies of organization for economic co-operation and development [14].

Professional competencies incorporate knowledge, skill as well as attribute those points to the capabilities to effectively perform a certain professional role. There are competencies that must be possessed by a requirement engineer while having their job

interview. In the recent economic era, requirement engineers must be more creative as well as collaborative towards the technique that are used for problem solving. While industry is also interested in requirement engineer who have soft-skills and can perform a verity of tasks. Thus, requirement engineers not only possess the hard cognitive skills that are associated with requirement engineering but also the soft skills just like interpersonal and intrapersonal, which are linked to communication, adaptive and collaboration, to perform effectively [16].

Requirement engineering competencies are the personal characteristic of a requirement engineer that impact how he/she approaches a requirement engineering task and gathers the required data. Thus, to cope with the requirement engineering challenging tasks, the competencies of a requirement engineer will be identifying and their impact for the requirement engineering process will be considered.

III. SYSTEMATIC LITERATURE REVIEW PROTOCOL

The systematic literature review (SLR) is used as a methodological approach to collect the evidence from literature in context of competencies required for RE. The major steps of SLR which will be incorporated in this study is depicted by [17]. The SLR includes the following major steps such as review planning, conduct review and the last one is document review. The aim of this article is on the planning of the review regarding the competencies of software engineer. The outcome of this study is the review protocol. To define a review protocol prior is significant to conduct a systematic review, because this protocol has all the details of the procedures which will be followed during the conduct of the SLR. Thus, in this context the objective of the review targets the existing studies that are focus on software requirement engineer competencies.

A. RESEARCH QUESTIONS

Developing comprehensive research questions is an important step of SLR. It can help to find out expressive as well as specific questions that may impact the future research direction of the study. Given below are the designed research questions that are extracted from the study of literature.

RQ1. What competencies are required for software requirement engineers to perform RE activities?

RQ2. How the identified competencies impact the software requirement engineering process?

RQ1 aim is to identify the different competencies that are related to a requirement engineer, such as the one which are available in the literature. RQ2 is to capture the impact of competencies at the process of software requirement engineering. Thus, in this context specific studies will be incorporated from literature.

B. SEARCH PLAN

Preparing strings for searching as well as source identification and selection of articles are included over here. The search plan steps are mentioned below.

1. From research questions the major key terms are identified and most of the relevant alternatives of the key terms are also noted. All of these are mentioned in the given Table I.

TABLE I
KEY TERMS AND SUBSTITUTES

Major Key Term	Substitute of Major Key Term
Competencies	Professional competencies, Abilities, Capabilities, Capacities, Expertise, Adroitness, Skills.
Requirement Engineer	Requirement Analyst, Business Analyst, System Analyst, Requirement Manager, Application Analyst, Business System Analyst, IT Business Analyst.

2. For searching design, the search strings to fetch the relevant data via "OR". For example, Competencies OR Professional Competencies OR Capabilities OR Abilities OR Capacities OR Expertise OR Adroitness OR Skills. For the major key terms this step will be the same.
3. "AND" operator will be used to further narrow down the search. It will help to join various key terms substitutes. ((Competencies OR Professional Competencies OR Capabilities OR Abilities OR Capacities OR Expertise OR Adroitness OR Skills) AND (Requirement Analyst OR Business Analyst OR System Analyst OR Requirement Manager OR Application Analyst OR Business System Analyst OR IT Business Analyst)).

While executing the various search strings, we can modify it according to different databases like ACM digital library, IEEE, Elsevier and Scopus etc., to find out the relevant articles.

A. SEARCH PROCESS

To find out the maximum number of articles which are relevant to the study, there have need to perform the process of searching through the most relevant databases for the aforementioned title [17]. A brief detail of the search process is provided over here.

1. Literature Resources: ACM digital library, Elsevier, Scopus, IEEE, Springer are well-thought-out with respect to data searching. Journal papers, Workshop papers, Conferences, Chapters as well as Thesis which have been published and the technical reports from various databases will be selected.
2. Interval for Selection of Articles: Articles that have been published from 2012-2022 will be considered for review. Thus from 2012-2022 is the interval that we prefer to have articles from this specific interval.
3. Published Papers Selection: Articles that have been published will be incorporating into our review based on inclusion/exclusion criteria of articles.
 - a) Study Inclusion Criteria: Based on the inclusion criteria papers will be incorporated to the SLR. The inclusion criteria for the selection of articles is mentioned at the given Table II below.

TABLE II
INCLUSION CRITERIA FOR ARTICLES

Criteria	Articles Include
Level One: Major Key Terms to be Focused	-The study incorporates competencies of a requirement engineer.
Level Two: Citation of the Article	-Article cited in the literature but not mentioned at the database.

- b) Study Exclusion Criteria: Based on exclusion criteria the articles will be excluded. The study exclusion criteria is depicted in Table III.

B. SELECTION PROCESS OF PRIMARY STUDIES

Selected articles are based on the previously stated inclusion and exclusion criteria. At the first step those articles are excluded that merely represent the contents in tabular form or represent information about conference as well as workshop. In the second turn articles title, major key words and abstracts are analyzed for inclusion/exclusion of a study. Thereafter those articles whose occurrence is more than one time are removed and only a single instance of them is included in the primary studies, which is judged upon the inclusion and exclusion criteria to be included or rejected for the considered SLR and may be forward to a second reviewer for further evaluation.

TABLE III
EXCLUSION CRITERIA FOR ARTICLES

Criteria	Articles Exclude
Level One: Papers having no research content.	-Papers having table of contents representation only. -Papers purely from conferences, workshops and lecture presentations.
Level Two: Major key terms, title and abstract Analysis of the paper.	-Papers not in connection with preferred title, key terms as well as abstract.
Level Three: Duplication Removal	-Repetitive studies in our database.

C. QUALITY ASSESSMENT OF SELECTED ARTICLES

To evaluate the quality of the selected papers there have a checklist provided by Kitchenham [17]. The checklist that will be used to assess the quality of selected articles is mentioned in the Table IV.

TABLE IV
QUALITY ASSESSMENT CHECKLIST FORM [17]

Question	Answer
Competencies are specified or not?	Yes/No/Partial
Competencies are significant or not?	-Do-
Does this research extends the knowledge?	-Do-
Doses multiple perspectives as well as background of a competency have been elaborated?	-Do-
Does difficulties/profundity and detail of a competency is mentioned?	-Do-
Dose strong as well as logical reporting have been performed?	-Do-

Guidelines discussed by Damir Azhar [18][19] having a gauge, which will be used while considering the Kitchenham checklist [17] to assess the study quality. This gauge is shown in the Table V.

TABLE V
GAUGE FOR ASSESSMENT OF STUDY QUALITY [18]

c	Values
Yes	1
No	0
Partial	0.5

D. DATA EXTRACTION METHOD FROM NOMINATED ARTICLES

There are forms which are designed to extract the required information. Data extraction form is depicted by Table VI. This form includes the content like Data Item, Extracted Data and Additional Note to store the selected study general contextual information. To extract the required data there may be multiple reviewers and results will be compared at the end. If there is a conflict it will be managed via reviewer's involvement.

Table VII is basically designed to have the competencies-based information in more specific manners. To synthesize the data related to the competencies this form will be helpful.

TABLE VI
FORM OF GENERAL CONTEXTUAL INFORMATION

Data Item	Extracted Data	Additional Note
Distinctive ID	An Identifier P(No.) (e.g.P<1>)	
Title		
Author(s)		
Year of Publication		
Type of Article	Journal, Conference, Report or Workshop	
Publisher		
Study Site	Industry or University	
Study Type	Survey or Experiment or Case Study etc.	
Status of Selection	Inclusion or Exclusion	Reason for inclusion or exclusion

TABLE VII
FORM OF COMPETENCIES

Research Question	Extracted Data	Additional Notes
What are the competencies that must a Requirement Engineer have?	-ID of Article -Reported Competency -Assigned ID for Competency	
How a competency impact the process of software Requirement Engineering?	-Impact of a competency -Highly occurred	
Which competency highly reported by literature?	competency among Requirement Engineer.	

E. SYNTHESIZING OF COLLECTED DATA

In this step the summarization of the collected data from literature will be performed. The aforementioned forms of extraction will provide the required data for analysis, such as to answer the queries represented in the Table VI and Table VII.

IV. CONCLUSION AND FUTURE WORK

A detailed procedure to conduct the systematic literature review in the area of competencies of requirement engineer is presented in this study. Based on this study we will identify the valuable competencies of a requirement engineer that must be exhibited by a RE, which will be a better contribution to the knowledge body of software requirement engineering.

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The authors declare they have no conflicts of interest to report regarding the present study.

CONFLICT OF INTEREST

The Authors declare that they have no conflicts of interest to report regarding the present study.

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