

SDLC-Based Software Development Decision Support Systems: A Systematic Literature Review

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Abstract:- The significance of software engineering has increased in today's technology-driven landscape, demanding the creation of high-quality software to satisfy market needs. Selecting the appropriate SDLC model is a fundamental prerequisite for crafting high-quality software, while a wrong choice can lead a software project to losses to some extent and even failure. A decision support system for software engineering ensures informed choices, optimizes the development process, and delivers robust, user-centric applications by providing the opportunity to choose the proper SDLC model. This paper represents a systematic literature review of the availability of decision support systems for software engineering. Moreover, this systematic review also focused on the commonly included SDLC models and their noteworthy features in existing software engineering decision support systems. The result showed that software engineering decision support systems were mostly proposed between 2015 to 2019. Agile, Waterfall, and Scrum are the SDLC models that have been included predominantly in the existing studies and the most highlighted features are project size, requirement transparency, change flexibility, and budget.

Keywords:- Software Engineering Decision Support System, Software Engineering, Decision Support System, Systematic Literature Review, SLR, Software Development Life Cycle, SDLC.

I. INTRODUCTION

Software engineering is one of the most trending works in this era as various kinds of software are being used daily[1]. Producing upscale software has become necessary to meet market requirements and make human life easy. Software development life cycle, also known as SDLC, is a methodology that aims to develop upscale software with the best outcome, including all the phases in a software engineering project focusing on different areas and interests [2]. The major phases of SDLC consist of requirement analysis, planning, software design, software development, testing, deployment, and maintenance [3]. In software engineering, to create high-quality software, every step must be properly executed, from planning to delivery [4]. To make upscale software, it is a must to choose the right SDLC model for specific software by matching the requirements and features.

A decision support system (DSS) is employed to enhance the decision-making process through the analysis of extensive data, presenting information in an organized fashion along with the best available options. [5]. A decision support system for software engineering helps the decision-makers of the software development team to choose the correct SDLC model.

For software engineering projects, choosing the wrong software development model can lead to problems like exceeding the budget or the deadline, not getting enough resources at the time of need, or even failure of the entire project. So, making the right choice of the SDLC model is a must in the early stage of developing software for the improvement of the team's productivity, software quality, defects reduction, cost reduction, and product maintenance [6]. Every SDLC model has its characteristics, criteria, and different working processes [7]. Finding the correct fit for a particular project is quite hard, as it will take a lot of time to research this. So, a software engineering decision support system can ease the process of decision-making and choosing the accurate SDLC model for every unique project.

According to this research, several studies proposing software engineering decision support systems have been found. However, there has been no systematic literature review exists for such studies. Therefore, this paper conducts a systematic literature review regarding the availability of the software engineering decision support system and the most popular SDLC models in decision support systems along with their mentioned features.

The structure of this paper is as follows- Section II presents the research methodology, Section III showcases the results obtained for the research questions, and Section IV provides the concluding remarks.

II. RESEARCH METHODOLOGY

This study has been conducted by systematic literature review (SLR) approach following the guidelines set forth by B. Kitchenham [8]. This SLR is a comprehensive and rigorous method that involves research question(s), selection of the databases, setting search terms, determination of inclusion and exclusion criteria, data extraction, quality assessment, and data synthesis. The outcomes obtained from a systematic literature review are more accurate, coherent, and impartial compared to those of a conventional review[9]. The procedure of the SLR is presented in TABLE I.

Table 1: Contents of the SLR

Procedure	Content of the method
A	Research questions
B	Selection of databases
C	Search procedure
D	Search results
E	Screening
F	Data extraction
G	Quality assessment
H	Data synthesis

A. Research Questions

While undertaking a systematic literature review, the research questions are vital in determining the approach to conducting the search, extracting, and analyzing data. The research questions chosen for this particular study are listed below:

- **RQ1.**How many existing studies are available on the software engineering decision support system?
- **RQ2.**Which SDLC models have been commonly used in the software engineering decision support system?
- **RQ3.**Which features of SDLC models are considered in existing software engineering decision support systems?

B. Selection of databases

In this paper, for the search process of SLR, the following prominent electronic libraries were included:

- IEEE Xplore.
- Scopus.
- ACM Digital Library.

C. Search Procedure

The search process has been performed by utilizing the following search string to select the relevant studies: ("decision support system" OR "software engineering decision support system" OR "software development decision support system") AND ("software engineering" OR "software development" OR "software development life cycle" OR "SDLC")

D. Search results

Searching through IEEE Explore, ACM Digital Library, and Scopus using the above-specified search string resulted in a total of 242 papers (till 06 Aug 2023) after removing duplicates.

E. Screening

As of the search, 242 studies were initially selected for the screening process. The screening process involved applying the following inclusion and exclusion criteria:

➤ Inclusion criteria:

- Studies focused on software engineering decision support systems.
- Studies published in peer-reviewed international journals or international conferences.
- Papers that were written in no other language than English.
- Available papers from the year 2000 to 2023 only.

➤ Exclusion criteria:

- Studies that do not focus on decision support systems for software engineering.
- Studies that are not published in peer-reviewed international journals or international conferences.
- Papers that are not written in English.
- Papers that are not from the year 2000 to 2023.

By employing these criteria, 25 papers were finally included out of 242 papers for the literature review.

F. Data Extraction

A data extraction form was created to record the relevant data from the included articles. The following information was extracted from each of the studies:

- Publication year.
- Name of the database.
- Offering software engineering decision support system. (yes or no)
- Offering software engineering decision support systems for choosing the right SDLC model. (yes or no)
- SDLC model(s) name.
- Feature(s) of SDLC model.

The first author performed the first level of data extraction, and the second author did verification simultaneously.

G. Quality Assessment

Quality assessment is essential in a systematic literature review to ensure the credibility and reliability of the selected studies. The quality of this study was assessed by the following questions:

- Is the study well-cited?
- Does the study follow proper research methodology?
- Is the study about the software engineering decision support system?
- Are the data collection procedures clearly described in the study?

The assessment questions mentioned above were marked as 'Yes' if they were satisfied, otherwise marked as 'No' for each.

H. Data Synthesis

Data synthesis in SLR refers to the process of analyzing and combining relevant information from included studies to derive meaningful conclusions and insights. In this study, the data synthesis was conducted as a narrative summary including some graphical representation by using the extracted information after quality assessment.

I. Review Protocol Validation

Kitchenham's guidelines [102] were followed to review the SLR protocol and ensure a comprehensive review process. Moreover, we decided to consult an expert in SLR methodology to establish a systematic, thorough, and all-encompassing process. As part of this, we sought the validation of the review protocol from an associate professor of the Department of Computer Science at the American International University-Bangladesh.

III. RESULT & DISCUSSION

This section presents the results related to the research questions and engages in discussions about them.

RQ1-Answer: Fig. 1 shows the number of studies about software engineering decision support systems published from 2000 to 2023. From the graph, it can be seen that there were no published studies about this topic before 2005. Only 9 articles were published before 2011 on this topic.

On the other hand, there are 36 papers were published after 2011 about the same topic. Most of the decision support systems were proposed from 2015 to 2019. After 2019, the trend has gone downwards.

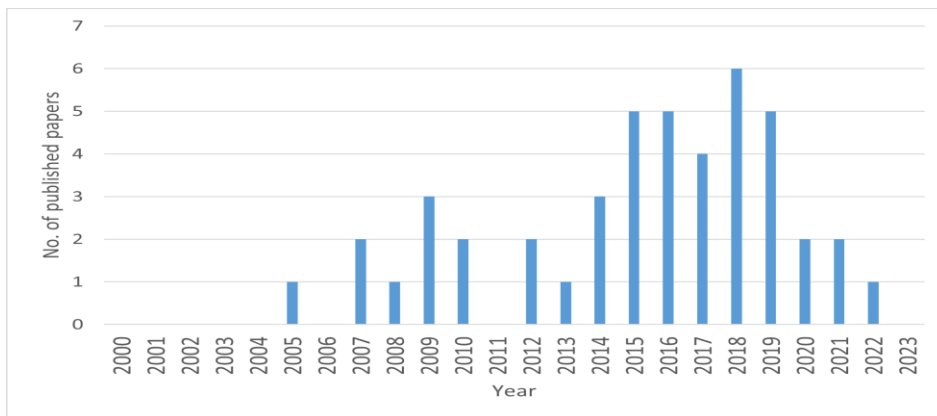


Fig. 1: No. of papers published each year on the decision support system for software engineering.

These findings provide insights into the development of software engineering decision support systems over time, highlighting key periods of growth and innovation.

RQ2-Answer: From 25 included studies, most of the articles are factor specified, such as decision support system for cost estimation, error detection, reliability measurement, etc. Very few studies include a decision support system for choosing the right SDLC model for the specific requirements of each software project.

12 papers out of 25 included papers illustrated the decision support systems for choosing the SDLC models for software engineering. However, most employed software

development life cycle models are Agile, Scrum, Waterfall, Iterative, Incremental, Extreme Programming, Spiral, DSDM, V-shaped, RUP, and RAD models.

In Figure 2, it can be seen that Agile, Waterfall, and Scrum are the common SDLC models that are included in all the mentioned previous studies. In addition, Iterative, Extreme Programming, DSDM, Incremental, and Spiral models were included in 8 of the studies. The rest RAD, RUP, and V-shaped models were used in 5 of the articles. Also, there were a few different models that were also mentioned in some of the research articles, which have been considered negligible.

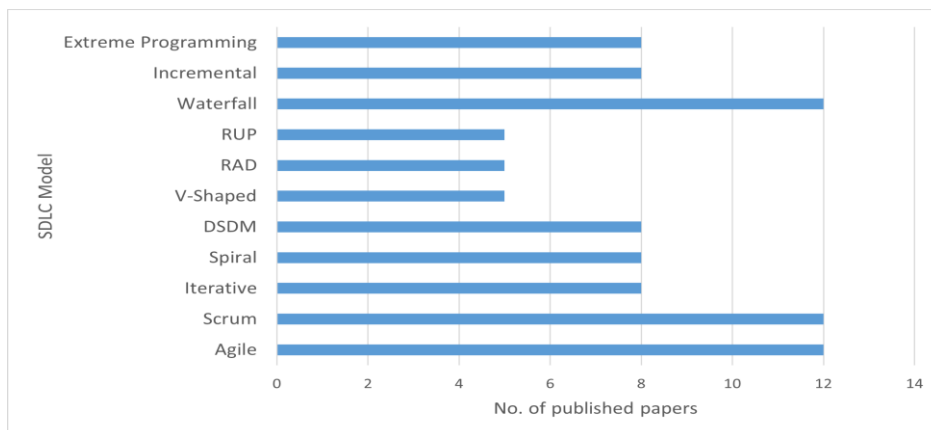


Fig. 2: Commonly used SDLC models in the mentioned previous studies of decision support systems for software engineering

RQ3-Answer: Different articles interpreted the features of the SDLC models in different manners. By combining

them, we have represented the SDLC models' noteworthy features in the pie chart below:

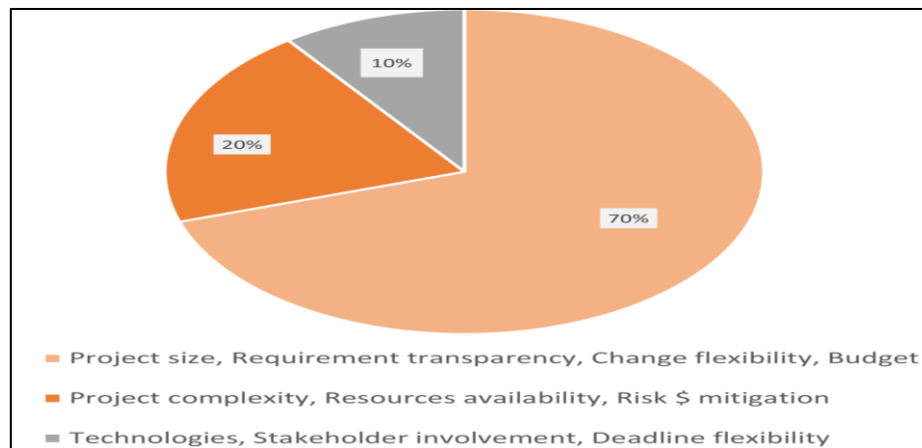


Fig. 3: The highlighted features of the SDLC models in the mentioned previous studies of decision support systems for software engineering

Project size, requirement transparency, change flexibility, and budget are the most considerable features of the SDLC models. Other important features include project complexity, resource availability, risk & mitigation, technologies used, stakeholder involvement, and deadline flexibility. Besides, some other features seen in the software engineering decision support system are project timeframe and required expertise.

IV. CONCLUSION

This study has conducted a systematic literature review on the software engineering decision support system with a focus on the literature's availability, the SDLC models that were most frequently used in the decision support systems, and their key features. The study found that this research area has been actively conducted from 2015 to 2019. Most of the decision support system does not include the system for choosing an SDLC model for developing specific software, but few studies do. However, the most common SDLC models used in available software engineering decision support systems include Agile, Scrum, and Waterfall models. Most often, Project size, requirement transparency, change flexibility, budget, project complexity, resource availability, risk & mitigation, technologies used, stakeholder involvement, and deadline flexibility are taken into consideration while selecting an SDLC model.

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