

# COMPARING THE TRADITIONAL AND NEW APPROACHES OF SYSTEM REQUIREMENTS MODELING

<sup>1</sup>LINDITA NEBIU HYSENI, <sup>2</sup>ZAMIR DIKA

Faculty of Contemporary Sciences and Technologies, South East European University  
E-mail: <sup>1</sup>linditanebiu@hotmail.com, <sup>2</sup>z.dika@seeu.edu.mk

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**Abstract** - The information system development is supported by conceptual modeling through the requirements communications to the client during the analysis and design phase. Based on the research conducted, the traditional approaches divided the functional requirements (FRs) and non-functional requirements (NFRs) in two different conceptual models, while in communication with the clients, only the conceptual model of the functional requirements is being addressed. Therefore, the traditional approaches have been started to be challenged by scholars because of the continuance of the still high failure rate of the information systems. The focus of the paper is the comparison of the traditional and new approaches based on the literature review and the client's and developers' perspective. This outcome contributes to the research community to continue the idea of integration of the functional and non-functional requirements in one conceptual model because of its importance during the system development.

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**Keywords** - Conceptual Modeling; Functional and Non-Functional Requirements; Traditional Approaches; New Approaches; Information Systems

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## I. INTRODUCTION

During the analysis and design phase it is very important the method of communication of the functional and non-functional requirements to the stakeholders (client) of the information system. The conceptual modeling is becoming an important instrument because it represents an important activity for creating a scheme that elicits and describes the information system simply but qualitatively. Based on the research conducted the quality to the conceptual models are strongly related to the final quality of the information system [1], [2], [3], [4].

The scholars who treat the traditional approaches separated the functional requirements (FRs) and non-functional requirements (NFRs) in two different conceptual models (CM), thus creating two requirement documents, while in communication with the client are being addressed only the FRs. Currently, the traditional approaches have started to be challenged by the scholars mainly due to not addressing the NFRs in one conceptual model together with FRs [5].

The aim of this paper is to compare traditional and new approaches to conceptual modeling based on literature review and client and developer perspective which is received through semi structures interviews in the Higher Education Institution called South East European University. The rest of the paper is organized as follows. In the section 2 are presented the traditional approaches to conceptual modeling while in the section 3 are described the new approaches to conceptual modeling. The comparison of the traditional and new approaches is given in the section 4 whereas in the section 5 is presented the conclusion and future work following the used references.

## II. TRADITIONAL APPROACHES TO CONCEPTUAL MODELING

The earliest paper about conceptual modeling of the information system (IS) was introduced by Borgida (1986) who paid attention to the IS development claimed that it can be developed more easily and can be used in a more natural way by concentrating on the semantics of the application domain. [6]. In the meantime, there are published several papers about conceptual modeling, but most of them also do not define if the conceptual model (CM) is for functional requirements or non-functional requirements, therefore two relevant articles that define type of requirements which are presented by Fatwanto and Boughton (2008) are selected [7], [8]. One of the articles has treated the conceptual models of the functional requirements (FRs) by presenting the method for analyzing, specifying and developing the CM especially in context of the translative model-driven development [7]. The other article has treated the conceptual models of the non-functional requirements (NFRs) by presenting the method for analyzing, specifying and developing the CM [8]. The authors have tested both methods through case study of the Voter Tracking System. The scholars have also published a small number of articles related to the guides for the requirements documentation which contributes a lot to the requirements engineering. The relevant article presented by Sommerville, I., & Sawyer, P. (1997) introduced a practice guide for functional requirements documentation which is applicable to any type of the system. The guide was created based on the authors' experience in research and development of systems [9]. Another, interesting article which treated the guide for functional requirements documentation via requirements abstraction model (RAM) is presented by authors Gorschek, T., & Wohlin, C. (2006). This

model prioritized and packaged the functional requirements of the system in the document before the development [10]. Once again, the authors Sommerville, I., & Sawyer, P. (2015) provided a guide for functional and non-functional requirements documentations. In this guide, the functional requirements are divided in different documents from non-functional requirements while only the functional requirements document is presented to the client [11].

Moreover, by literature review is identified that the scholars are concentrated on the determination of the requirements in the meetings with the clients even though they have begun to initiate the validation of the requirements but not the approval of the requirements. Currently, two types of techniques are used during the session with the client, one of the techniques is Joint Requirements Planning (JRP) which is presented by Bentley, L. D., & Jeffrey, L. (2007) and the other technique is called Joint Application Development (JAD), which is presented by Dennis, A., Wixom, B. H., & Roth, R. M. (2012) [12], [13]. Even though, the JRP technique is for the requirements identification, analysis and definition, it has mentioned the validation of the requirements as optional during the JRP session with the client.

The advantages of using the JRP technique are that users and management are actively involved in the project development, thus a time period for facts finding in planning and analysis phase is decreased. They are confirming the requirements and approving only the prototypes if available, making a formal written document and publishing it at the end of the JRP session by maintaining the momentum of the session [12]. Whereas, the JAD technique is only for the definition of the requirements. This technique allows identification of the system requirements in the JAD meetings by the project team, users and management. The JAD technique is used in the analysis and design phase [13].

In the traditional approach, there were occasions where the integration of FRs and NFRs is handled by the authors Cysneiros and Leite (2004), but their results show that the impact in the development process was not significant due to the used strategy [14]. In addition, the authors Chin Boo Soon and David C. W. (2010) show the importance of the non-functional requirements in the cloud based solutions development as the new paradigm.

It is important to mention that during the studies they found no differences in the analysis phase of creating a Cloud based solution, while there are potential challenges specifically in the design phase, the database schema, use of queues, access control, workflow, service bus and query efficiency. As a result of the study they provided some design considerations Cloud based solution [15].

### III. NEW APPROACHES TO CONCEPTUAL MODELING

Nowadays, scholars are beginning to treat the integration of the functional requirement (FRs) and non-functional requirements (NFRs). An article presented by the authors Eckhardt, Vogelsang, and Fernández (2016), gives a hint about the integration of the FRs and NFRs by handling most of the NFRs similar to the FRs [16]. This hint was the motivation for proposing the Integrated Framework for Conceptual Modeling (IFCMod) which integrates functional requirements (FRs) and non-functional requirements (NFRs) in one conceptual model (CM), producing one requirements document (FRs & NFRs DOC) in order to influence the success rate of the information system to be developed. Within this IFCMod is proposed also the new revised method called Joint Approval Requirements (JAR) for review and approval of the FRs & NFRs DOC and the CM by the client in the JAR meetings [5]. This IFCMod algorithm consists of the following components [5]:

The guide for the functional and non-functional requirements documentation (GRDOC) which contains document instruction (DINST) for creation of the requirements document (FRs & NFRs DOC) based on the gathered requirements (GRs) from documents and texts, the analyst's impressions and reactions, observations, interviews and questionnaires.

- The guide for quality of modeling instructions (GQMI) which consists the modeling instruction (MINST) which applies the quality in the integrated conceptual modeling.
- The guide for graphical representation of integrated conceptual model (GGRICM) which presents the modeling manner based on the GQMI and FRs & NFRs DOC.
- The proposed instrument for designing integrated conceptual model (IDICM) which is functional on premises as well as on cloud platform.
- The method called Joint Approval Requirements (JAR) which is for review and approval of the FRs & NFRs DOC and the CM by the client in the JAR meetings.

### IV. COMPARISON OF THE TRADITIONAL AND NEW APPROACHES

In this section is presented the comparison of the traditional and new approaches to conceptual modeling based on literature review for the period 1986-2016. The comparison is also given from the client's and developers' perspective based on their answers in the semi-structured interviews related to the used traditional approaches (Agile Methodology) during the e-Schedule system analysis and design in the South East European University and based on the presentation of the new approaches called Integrated Framework for Conceptual Modeling (IFCMod).

In the following table 1, are presented the different aspects of the traditional and new approaches which are treated by different scholars.

**TABLE I. Comparison of the Traditional and New Approaches**

Treated aspects	Approaches	
	Traditiona I (1986- 2015)	New (2016)
Functional requirements (FRs)	✓	
Non-functional requirements (NFRs)	✓	
Integration of the FRs and NFRs	✓	✓
Guides for integration of the FRs and NFRs in one conceptual model		✓
Propose adequate instrument for designing the integrated conceptual model		✓
Guide for FRs documentation	✓	
Guide for NFRs documentation	✓	
Guides for FRs & NFRs documentation in one document		✓
Joint Requirements Planning (JRP) Technique	✓	
Joint Application Development (JAD) Technique	✓	
Joint Approval Requirements (JAR) Method		✓
On system analysis and design phase	✓	
In selecting the adequate instrument		✓

<sup>a</sup>The **tick** symbol shows what aspects are treated in the traditional and new approaches to conceptual modeling

As shown in the table 1, in the traditional approaches is a missing guide for integration of FRs and NFRs in one conceptual model, as well as is a missing guide for integration of the FRs and NFRs in a requirements document. Whilst, comparing traditional and new approached in category of requirements communication to the client, the traditional approach have two techniques the JRP and JAD techniques but none of the techniques has the review and approval process of the requirements by the client in the meetings as the JAR method has in the new approach [12], [13], [5]. The last category in table 1 is the cloud computing impact, it is treated by both approaches but in a different perspective. The traditional approaches shown the impact of the cloud computing in analysis and design phase, while the new approach presents the impact of cloud computing in selecting the adequate instrument for designing the integrated conceptual model. Only one aspect of the conceptual modeling is treated by both approaches in same perspective, this is the integration of the FRs and NFRs. In the traditional approaches, the integration of the FRs and NFRs was treated by the

authors Cysneiros and Leite (2004) but was not successful because of the used strategy [14] thus, the new approaches called the Integrated Framework for Conceptual Modeling (IFCMod) is proposed for integration of the FRs. and NFRs [5]. This IFCMod is supported by clients and developers of the South East European University based on their participation in the presentation of IFCMod components. In the end of the presentation are collected 26 semi-structured interviews from 13 interviewees (4 developers and 9 clients), 13 interviews per new approach and 13 interviews per traditional approach. All subjects had more than 5 years' experience in the South East European University (SEEU), 3 of them held top management positions, 2 held a managerial position and the others held non-managerial positions. Their experience and held positions in the SEEU means that they were competent for answering to the semi-structured interviews.

Before analyzing the results of this study, it is treated the dilemma which was about small number of sampling of the Semi-Structured Interviews. According to the authors Ghazi, A. N., Petersen, K.,

Reddy, S. S. V. R., & Nekkanti, H. (2017) this is a problem in the field of software engineering, therefore they have study this problem. During their study, they have done a literature review and 9 semi-structured interviews with software engineering researchers to elicit their view on problems and strategies [17]. As well as the authors Marshall, B., Cardon, P., Poddar, A., & Fontenot, R. (2013) in their study about sample size in qualitative research concluded that the data saturation had occurred by 12 interviews, while theoretical saturation generally occurs between 10 and 30 interviews [18]. The authors concluded that the single case study should

generally contain 15 to 30 interviews. Also, according to the authors Malterud, K., Siersma, V. D., & Guassora, A. D. (2016) information power indicate the lower number of participants in the interviews. Information power which depend on the aim of the study, sample specificity, use of established theory, quality of dialogue, and analysis strategy [19].

In the following table 2 is presented the chi-square test of the answers related to the question, if the IFCMod is need during the system analysis and design of the information systems?

TABLE II. CHI-SQUARE TEST - NEW APPROACH (IFCMod)

Pearson Chi-Square: 0.026

Perspective	New integrated approach		Total
	Needed	No Need	
Clients	23.1%	46.2%	69.2%
Developers	30.8%		30.8%
Total	53.8%	46.2%	100.0%

Based on the chi-square test in the table 2, 23.1% of the clients and 30.8% of developers are responding that the IFCMod is needed, while 46.2% of clients are answered that the IFCMod is not needed. From 53.8% of the client and developers who are response that the IFCMod is needed, they share their perspective as following: The IFCMod will speed the system development, It will frames the project scope and way how to progress to the final solution, with IFCMod will not have misunderstanding regarding

the processes of the system, the product of the IFCMod will be better and simpler for developers to understand how to develop the system, there is a need for a new formal approach for requirement specification document. Whilst, the client`s and developers` perspective regarding to the traditional approaches (JRP Techniques) used in a quarantine for analysis and design of the e-Schedule system in the South East European University are presented in the following table 3 of chi-square test.

TABLE III. CHI-SQUARE TEST - TRADITIONAL APPROACH (JRP Technique)

Pearson Chi-Square: 0.009

Perspective	Do you think that the product of the quarantine had the deficiencies in its content?		Total
	Yes	No	
Clients	15.4%	53.8%	69.2%
Developers	30.8%		30.8%
Total	46.2%	53.8%	100.0%

Based on the chi-square test in the table 3, 15.4 % of the clients and 30.8% of developers are answered that the product of the quarantine had the deficiencies in its content. They shared the following perspective related to the product of this quarantine: the main and sub processes of the e-Schedule system was not fully described as they are, the final version of the product was not fully completed therefore, was not ready for development. Moreover, the graphical representation of the system has missed to the product of the quarantine which leads to misunderstanding of the system by all participants. While, 53.8% of clients are answered that the product of the quarantine had no

deficiencies in its content but is highlighted that it was prepared only for functional requirements.

## CONCLUSION

Considering the comparison of the traditional and new approaches, it is obviously clear the need for the new approach which integrates the non-functional requirements with functional requirements in one conceptual model.

The first signs of the successful results of the proposed integrated approach are shown through semi-structured interviews but there are also expected

results from the other researchers in order to increase the success cases which would prove the contribution of the new approach called Integrated Framework for Conceptual Modeling (IFCMod).

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