Approaches in Creating Meta-requirement: A Systematic Literature Review

Muhamad Idaham Umar Ong1,*, Mohamed Ariff Ameedeen1, Imran Edzereiq Kamarudin1

1Faculty of Computing, College of Computing and Applied Sciences, University Malaysia Pahang, Gambang, 26300, Malaysia

* Correspondence: idaham@ump.edu.my

Abstract. Common development team will spend less resources on User Requirement Specification (URS) validation, in the case of development project that provides this URS in the phase of competing for tender. In order to overcome this, the use of meta-requirement in evaluation of requirements is being introduce. The purpose of this article is to present the finding of a systematic literature review of meta-requirements. A methodology that involve defining a systematic way of finding literature and presenting it in a meaningful manner has been adopted. Meta-requirement is an area that is station within the field of information system design theory which is contain in the design research body of knowledge. Based on the result of the analysis of the systematic literature review, it is shown that there is still advancement in the field of meta-requirement and there still improvement that can be done to further the knowledge and contribution in this area. It is suggested that further research that will define a highly comprehensive model of creating meta-requirement should be undergo and the issue of meta-requirement traceability against real-world requirements should be tackle.

1. Introduction
The term Software Engineering represents a knowledge area involving the activities of software development that should include requirements documentation, design principles, and other artifacts that will be the basis of the inner workings and deliverables functionality of a requested software product by the relevant stakeholders [1]. User requirements specification (USR) is one of the most critical artifacts in software development, representing the needs and the wishes of the stakeholder in a form of high-level abstract. Most common USR are being presented in the form of natural language such as use case descriptions, user stories, etc. [2]–[6].

Current issue and challenges in the intention of producing correct list of requirements through the process of requirements validation are; (1) Review process (2) Reviewer team (3) Requirements specification (4) Validation support tool (5) Organizational culture and (6) Governance [7]. The statistical data shown in a research done in 2011, major percentage of defect is originated from Requirements Engineering phase with a total of 56%, while design phase, coding phase and other phases are only concurred 27%, 7% and 10%. If the Requirements Engineering phase is being done correctly with the right method and technique, this will immediately affect the future phases by reducing the number of defects that will be discovered [8]. This is where the stated challenges will be overcome with the usage of meta-requirement.
The meaning of the term “meta-requirement” was described as classes of goals to which the theory (kernel theory) applies. The used of the term “meta-requirement” [9] was to simplify requirements in a sense where a design theory doesn’t address a single problem but a class of problem. Another researcher defines meta-requirement as the source of today’s system function. It is a minimum and indivisible requirement component. Requirement information may be a meta-requirement or a collection of meta-requirement [10]. Kaiya define meta-requirement as all requirements follow some laws when the requirements are proper. The author call such laws as meta-requirements [11].

The main objective of this paper is to summarize published literatures to build and present an overview of existing studies on meta-requirements in the context of meta-requirement creation. The second objective of this publication is to identify the major factors impacting and meta-requirement. Third is search for the unit of measurement(s) used to measure meta-requirement. And the fourth objective of this paper is to identify the limitations and future research in the field of meta-requirement creation in order to suggest areas for further research.

2. Meta-Requirement Literature
Based on a systematic literature search done throughout major scientific and academic databases, in the matter of meta-requirements there four names that are being considered as the founding fathers of meta-requirement. Their contribution towards meta-requirement are in the field of Design Research, more specific in Information System Design Theory (ISDT).

Meta-requirements as describe by researchers is the most basic form of requirement. Its main role in ISDT as the main artifact that describe the most basic function that a system must have, well in theory that is. The definition of ISDT is an initial draft of establish relationships between components of a system to achieve a specific result. Design theory must address the question of how to combine components and relationships to make subsystem and how to combine subsystems and relationships to make a systems [9].

In 1992, a work by J. Walls, Widmeyer, & El-Sawy [9] is the first to include the phrase “Meta-requirement” in his work and not just a buzzword with any relation to the field of ISDT. The future work that comes afterword in relation meta-requirement majorly in the field of ISDT, highly cited his work. Meta-requirement that was presented in his work is quite green, whereby future researchers has made improvement in the meta-requirement is being presented.

Käkölä, Koivulahti-Ojala, & Liimatainen [12]–[14] develops the product aspects of the ISDT for the class of Requirements and Release Management Systems (RRMS) with the involvement of meta-requirement. Advancement has been done thorough this work whereby the researcher introduces a different way of presenting meta-requirement. This is the first author to used 2-dimensional representation of meta-requirement that shows some quality type attributes to the meta-requirement itself.

3. Systematic Literature Review Methodology
This section will describe the method that will be used to conduct the systematic literature review. A detail explanation of Figure 1 will be made available in a journal publication. The research questions that will be answer at the end of the methodology are as follows:

- RQ1: What are the earliest and latest research works regarding meta-requirement?
- RQ2: What are the type and important factors in representing meta-requirement?
- RQ3: What are the limitations of existing work in the field of meta-requirement?
4. Result and Discussion

4.1. Earliest and Latest Research Works
Based on the result of the literature review, research on meta-requirement has been done way back since the early 90’s and still continue until today. Even though the number of publications on meta-requirement are not popping up that frequent, it is also showing that there is still a lot that can be improve within the field of meta-requirement. Figure 2 shows the frequency of relevant publication based on year 2004 to 2018.
There are multiple researches that utilize the work of [9] such as [15], [16] in designing their needed solution based on the knowledge of design-science research. In the mist of these current researchers contribution and citation to [9], there are few researcher focus on the intervention that is needed in improving the knowledge of ISDT framework. Some researchers such as [12]–[14], [17]–[19] included a few improvement in the attention of contribution towards the presentation of meta-requirement in ISDT. But our focus will be more on the process of producing and validating in the process involve from kernel theory to meta-requirement in the ISDT. A major finding in the work of [20] stating that there is no explicit guideline existed in deriving meta-requirement from the selected kernel theory.

Throughout the 45 selected studies, 3 different authors and their method of deriving meta-requirement are being applied by those researchers. First ever publication which give meaning to the word meta-requirement in the word of information system development was [9]. Meta-requirements was one of the product produce by Walls ISDT (refer to Figure 4) and was widely cited by researchers. The detail and in-depth information on the statistical number that were mention will be publish ion a separate journal.
Figure 4. Component of Information System Design Theory [9]

4.2. Type and Important Factors in Representing Meta-Requirement

The important factors of meta-requirements is mainly base on the kernel theory that will be used in the method of deriving meta-requirement itself. For the case of [13], important factors are based on eSourcing Capability Model for Service Providers (eSCM-SP). If there are standard and important factor that can be translated to meta-requirement characteristics and attributes for the scope of Information System (IS) development, it is shown in publication by [21] and [12]. A full publication with information related to the applied kernel theory with regards to the scope of develop system are presented in Error! Reference source not found.

Based on the systematic literature review, it is concluded that most of meta-requirement related publication are presented in the form of 1-dimensional rather than 2-dimensional, this is shown based on Figure 5, that shows the number of publications that uses 1- and 2-dimensions type of meta-requirement. Further detail information is being shown on Error! Reference source not found.

Figure 5. Meta-requirement Dimensional Presentation vs Quantity
4.3. Limitation of Existing Framework in the Field Meta-Requirement

Major contribution of the related publication is the creation of a design theory that can be use by future researchers in helping them to develop somewhat similar outcome. But this has also present limitation where throughout the course of this literature review. Based on the author knowledge, the following are the limitation discovered:

- There are no existing publication that shows the relationship of meta-requirement produced in ISDT or in part of the field of Design Science Research with the real-world artifacts, focusing on the relationship of meta-requirement and real-world requirement specification.
- Standard in depicting meta-requirements are not well established. Even though most of the researcher uses the similar syntactic define by [22], there is no clear research on the standard of writing meta-requirements. This was shown based on the findings of meta-requirement being presented in general language format or by following a syntactical format similar towards requirement engineering and the presentation of either single or 2-dimensional meta-requirement.
- Researchers [20] has commented that there is actually no explicit guideline in deriving meta-requirement. Even though it is clearly stated in the work of [9] the origin of meta-requirement, there is no instruction in the form of diagram or framework has been discovered throughout the progression of this paper.
- With the highly abstract nature of meta-requirement, there is no publication that shows other derivation of meta-requirement into other instance of an artefacts. For example, modelling meta-requirement seem not exist.
- No involvement of Object Management Group (OMG) in the context of meta-requirement in the field of Design Theory. This is a major indicator that meta-requirement is not included in OMG interest whereby most publication that are listed in this literature review are not references to OMG and meta-requirement is not define in any material produce by OMG. Even though [23]–[25] working on meta-requirement and also referencing towards OMG, it’s not a direct referencing.
- Throughout the whole process of executing the systematic literature review, there no clear significant of meta-requirement being established between it and the main Software Engineering body of knowledge that is Object Management Group (OMG). There was [24]–[27] who cited OMG in his publication but there are a few argument that is raised. First, throughout the journal there was no proper definition of the term “meta-requirement” mentioned. Second, relationship of meta-requirement and OMG was not clearly stated. And finally, its publication was not related to the well-published “meta-requirement” definition in the context of Design Theory.
- Meta-requirement as one of the by-products of ISDT. The main star in ISDT is meta-design where it uses meta-requirement and testable hypotheses as a stepping stone in making there are artefacts for check and balance when considering the usefulness of the meta-design.
- No major relation of requirements engineering and meta-requirement. Through the literature that was reviewed, most of them are in context of design theory and only a few [23] was consider as using meta-requirement in the core of requirements engineering. But there are a few factors that being consider of these publications whereby the background of meta-requirement is not well established compared in the context of DT.

5. Conclusion and Future Works

There is still limited work in meta-requirement at present that provide guideline in producing meta-requirement. The process of making sure the traceability of each artifacts that are related to meta-requirement in its core field of Information System Design Theory is also another matter that needs to be taken seriously. From the artifacts of kernel theory, meta-design in both product and process and testable hypotheses, all of them are closely related to meta-requirement. Even though meta-requirement
that is produce in ISDT is being consider as a theory, proving the effectiveness of the produced theory against its real-world counterpart is crucial.

Our future work will focus on formulating an algorithm that will function as a meta-requirement creation. The algorithm itself must be able to work in conjunction to ISDT environment taking into account every related artifact in the field. In order to achieve this vision, a systematic formulation and the right approach is needed to produce an algorithm that can work within the stated environment.

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Acknowledgments
This work was supported in part by University Malaysia Pahang under Grant RDU RDU191802-2.