Meta-Requirement Method Towards Analyzing Completeness of Requirements Specification

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Abstract— In software development project, requirements validation plays an important role to ensure all requirements are capture as required. With the correct sets of requirements, producing a highly desired system is possible. However, due to time constraint, requirements validation steps are commonly ignored by developer. The objectives of this research are to identify the major factors in validating user requirements, development of a reverse engineered meta-requirement algorithm and validating with expert panel in requirements engineering of the algorithm usefulness. Expected result will be that the solution should be able to reverse engineer the meta-requirements of a set of user requirements. By building a repository of meta-requirement, this will enable comparison of meta-requirements of two different system within the same domain and producing a meta-requirement gap analysis. With this, requirement validation steps can be done within a small amount of time. The contribution of this research should be beneficial to industry and researchers.

Keyword-Meta-Requirement, Requirements Specification, Validation, Requirements Completeness

I. INTRODUCTION

Over the years, efforts to produce high quality requirements specification artefact, mainly in the form of document and its content through the processes of elicitation, documentation, validation and negotiation and management has been the main priority for requirements engineers [1], [2].To produce the desired requirement specifications, the efforts relies on an effective method of how information is being obtained, sources that is relevant, understanding and translating those information in the correct context and based on those result, reaching a mutual agreement from different parties with highly diverse experience, knowledge and characteristic. This process itself is far from perfect and prone to errors.

Many previous research was conducted with different approach to ease the challenges faced by requirements engineers [3]–[5]. According to Pohl & Rupp, 2011, acknowledge that requirements must be communicated, and yet the way we human usually express those word to communicate with each other are most of the time confusing and sophistication. This also have yet to take any consideration in terms of different context of which how the information is intended to be digest, for example the inclusion of body language and sarcasm terms. Communication is one of the main issue when discussing the topic of requirements engineering.

According to Lang & Donovan, 2017, based on National Geographic documentary title Air Crash Investigation episode “Turning Point”, the case of Air China flight 129 from Beijing Capital International Airport, Beijing, People's Republic of China to Gimhae International Airport, Busan, South Korea; the main problem found was the miscommunications between the pilot and the air traffic controller. This tragedy is an example of clearly the problem of natural language communication arise in the scope of information receiver ignorance, information receiver biasness, lack follow up of information passing successfulness between information sender and receiver, missing of vital information such as weather condition at that crucial time period.

A. Problem Statement

Textual requirements satisfactory can be consider related closely to textual requirements whereby both uses similar measurements to produce the desired result. The lack of formal criteria and standard practice, which requires large amount of monetary resource when involving high assurance domain [7], [8] are the disadvantages of current techniques to access textual requirement satisfactory.

To ensure the completeness of requirements, current practice involve "*a tedious process of reading requirements and looking for linguistic errors*"[7], [9], [10]. The term *tedious process* is described through the study of different methodology of requirements validation in the scope of completeness.

Using algorithm in requirements validation technique to solve the problem of requirements validation have not been evaluated for the objective of overall completeness. With the development of the proposed algorithm to reverse engineer user requirements to its originated requirements (meta-requirement), it will help software developer practitioners to analyzed with a better outcome.

B. Objective

The objective for this research are as followed:

- To identify major features, factor, characteristic and attributes that influence towards requirement validation.
- To develop a model, method and technique for textual requirements validation.
- To evaluate the proposed technique for textual requirements validations based on expert opinion approach

II. Related Literature

This chapter will describe the literature that are relevant to the research that will the foundation of this research.

A. Holistic View of Requirements Engineering End-Product

In software engineering, requirements engineering is considered as a sub activity. This sub activity main focus is to ensure that a complete documentations of stakeholder requests in the form of user requirements is prepared and finalized before the design and implementation kick off. This documentation contains all the deliverables where an overwhelming amount of information describing the expectation set by the stakeholders.

In order for the design and implementation team gets a clear and complete view of the stakeholder's desired end-product, requirements engineer puts in a rigorous and complex methodology of requirements collection and analysis to make sure that the outcome of requirements engineering will be highly comprehensive and understandable. A detail description of different phases and sub-activity that are undergone throughout the process of requirements engineering is shown in Figure 1.

Requirements validation is the process of making sure that a complete list of agreed requirements to be included in the project. Similar to a furniture instruction manual, requirements engineers must ensure that they are building the correct "furniture", or the correct software and by making sure they are following the "manual instructions", or correct method in creating the correct software.

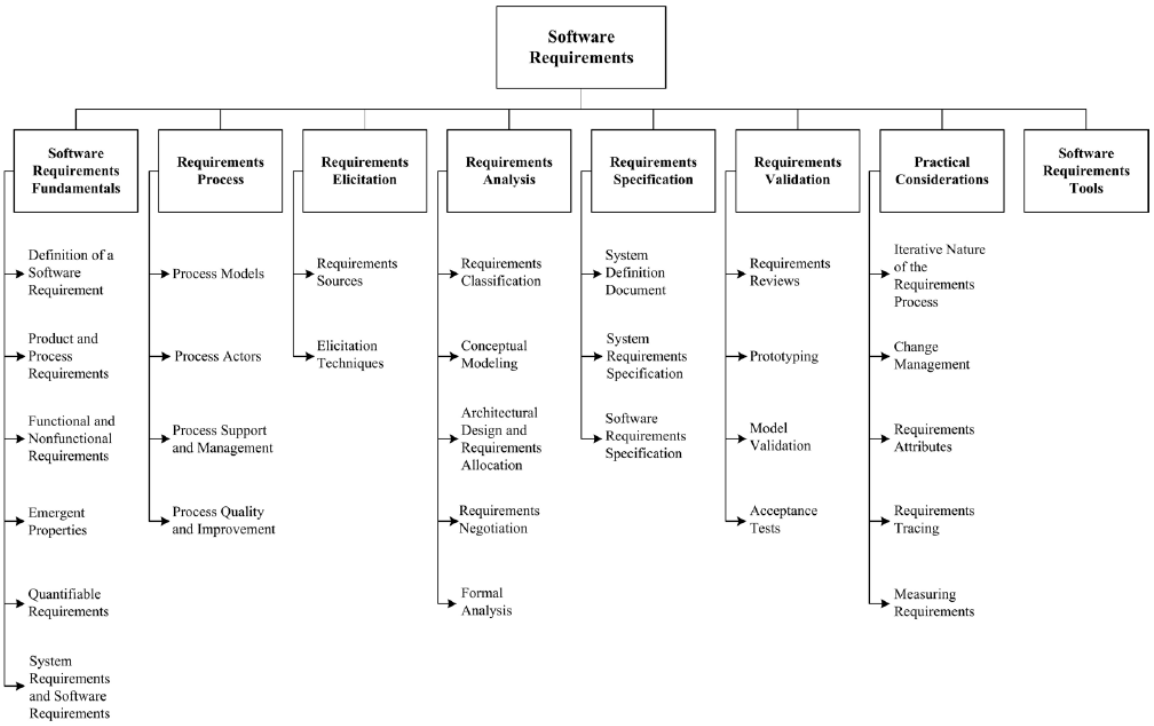

Fig. 1. Software Requirements as a Whole [11]

B. Meta-Requirements in Information System Design Theory

The meaning of the term "meta-requirement" was described as classes of goals to which the theory (kernel theory) applies. The term "meta-requirement" [12] was to simplify requirements in a sense that instead of addressing a single problem, meta-requirement address a class of problem.

The function of information system design theory (ISDT) is to describe to the software developers about the initial draft of establish relationships between components of a system to achieve a specific result. Design theory must be able to address how to combine components and relationships to make subsystem and how to combine subsystems and relationships to make systems. [12].

According to Käkölä, Koivulahti-Ojala, & Liimataine,2009, in regards to meta-requirements research, a framework for categorizing meta-requirements for the development of a Requirements and Release Management Systems (RRMS) has been produced based on the knowledge and implementation of ISDT.

TABLE 2
FRAMEWORK FOR CATEGORIZING THE META-REQUIREMENTS OF THE ISDT FOR RRMS [13]

Communication	**Control**	**Change**	**Platform Development**	**Process Integration**
Prioritization and valuation of requirements and the allocation of	Content ownership and accountability Management and	Version management of requirement documents	Creation and reuse of reusable assets Knowledge creating	Process transparency Providing information at the

requirements into releases Traceability Single capture of information	coordination Creating and sharing of metrics information Access rights and information security	Release re-planning Change management and impact analysis Defining and maintaining the requirements baseline	capacity	right level of detail Providing high quality information

The same researchers with the help of Salo & Kakola, 2005, they represented their framework of meta-requirement analysis in two dimensions. Similarity to the framework in TABLE 2 , this framework for analyzing meta-requirements also use for describing the meta-requirements of a Release Management System (RMS). This research was done in the environment of Nokia Research Center (NRC) and Business Unit (BU) for providing a groupware-based RMS for new product development (NPD).

TABLE 3
FRAMEWORK FOR ANALYSING META-REQUIREMENTS FOR RMS

RMS Use	**RMS Support**		
	1. Communication	**2. Control**	**3. Change**
A. Context	Development and application of domain models to support information sharing, storage, and retrieval across the functional units involved in NPD	Use of domain models in the allocation of responsibilities for the further processing of requirement information	Explicit definition of interfaces to other RMS instantiations Enforcement of controlled procedures for the revision of domain models
B. Process	Enforcement of jointly approved milestones for workflow support	Separation of processes for knowledge acquisition and decision making Clarification of decision criteria and rules for applying the criteria	Instantiation of alternative sub-processes for different kinds of requirements information
C. Content	Adoption of standard representational schemes in the description of requirements information	Accumulation of a full revision history with each requirement	Controlled introduction of revised guidelines for describing requirements

In another research [15], it includes two dimensions of categories and its being mapped to the meta-requirements of the Automated Teller Machine (ATM) system.

TABLE 3
META-REQUIREMENT ANALYSIS TO DEVELOP ATM SYSTEM

The three aspects of require-ment for developing ATM system	**The five requirement categories for developing ATM system**				
	Communi-cation	**Control**	**Change**	**Develop-ment platform**	**Process integration**
Environ-ment	Support information sharing, storage, and retrieval across the functional units involved in ATM system	Use the domain model in the allocation of responsibilities of ATM system, for further address the requirement information	Explicit definition of interface of ATM system to other instances of the system Different	Knowledge and innovative capability Reuse	High-quality information The support to relevant technical and policy
Process	The support to the workflow of	The decision criteria to develop	Different kinds require-ment	Reuse to creation and	Transparency in the development

	ATM system	the ATM system	information to alternative sub-processes	assets available	process to ATM system
Content	Adoption of standard representational schemes in the description of requirements information	The accumulation of comprehensive revision history for each requirement	Controlled introduction of revised guidelines for describing requirement	The effect of knowledge and innovation to ATM system	Provide the appropriate detailed

In conclusion, the meta-requirements produced by previous researches depends on the nature of the system itself. Different system utilizes different sets of meta-requirement category. This knowledge will be applied with great awareness within this research. With the use of category in meta-requirement analysis, the result will be much more comprehensive and clear.

III. Proposed Methodology

The research focus in the area of validation, specifically in requirements validation. As shown in Figure 2, a thorough process of literature review on related works is being conducted. This will define the base knowledge and recent advancement in the current research interest. This will also define the existing gap or area of improvement that will be the main theme of this research outcome.

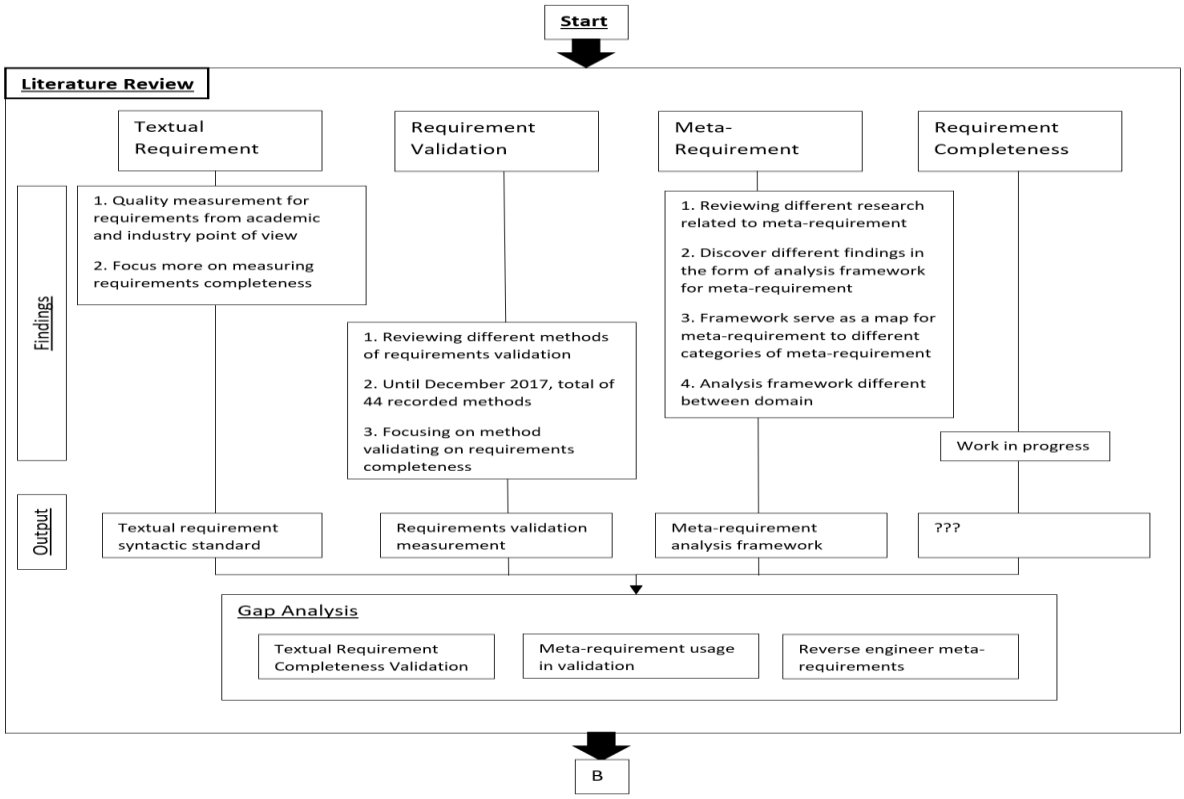

Fig. 2. Research Methodology Flow Chart Part 1

In Figure 3, the process continues to develop a proposed solution that will be based on the problem statement, and scope of research define in this research with reference to the review of related work in **Error! Reference source not found.**. By implementing the proposed algorithm in the proposed overall solution, the desire results of meta-requirement gap analysis between two different within the same domain should be achieved.

The final outcome of the solution should be validated through a series of experiment by using qualitative and quantitative analysis via expert panel (based on objective 3). This will ultimately define the opinion of expert panel on the knowledge and usefulness of meta-requirement usage in requirement completeness validation.

Lastly, through the result discover through the proposed experiment, it will then be discussed, and suggestion of future works will be derived.

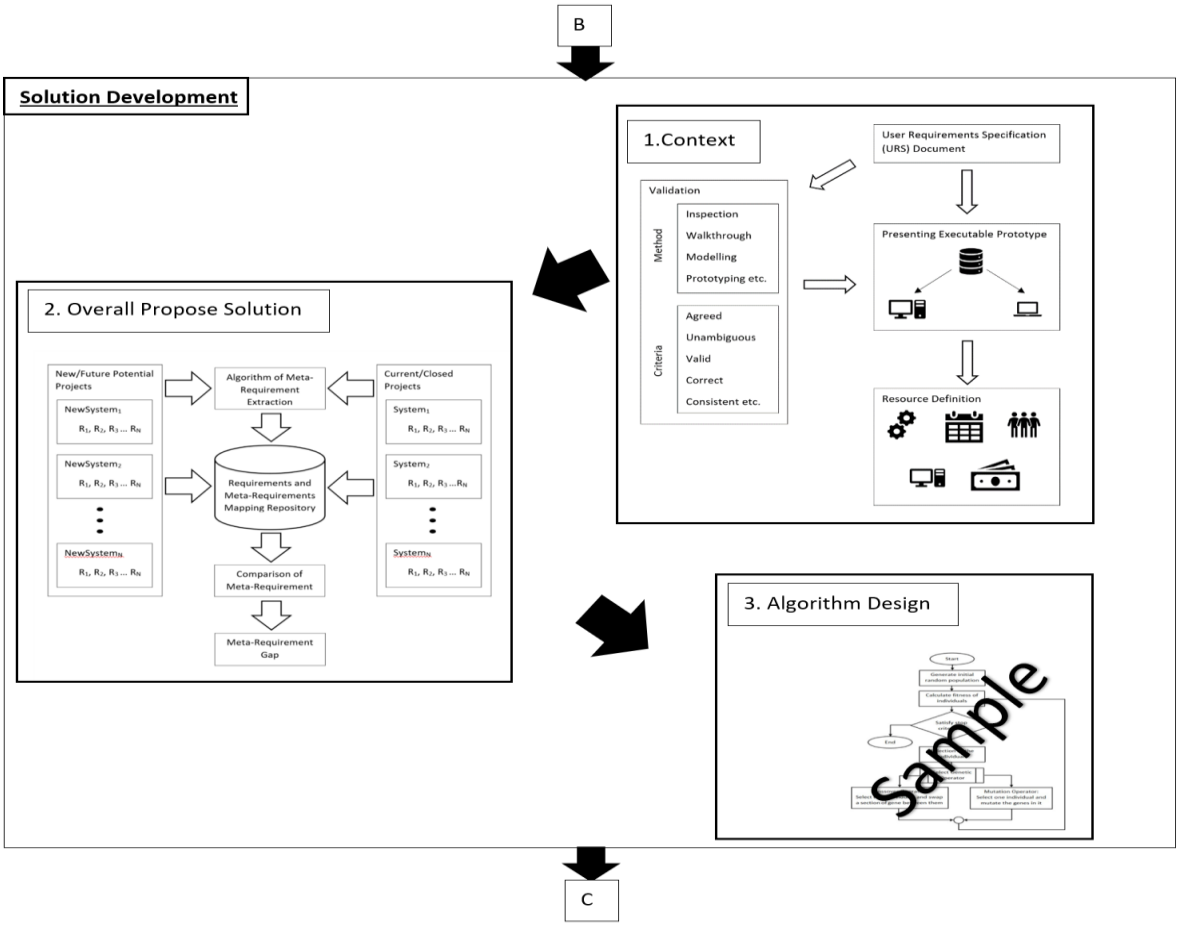

Fig. 3. Research Methodology Flow Chart Part 2

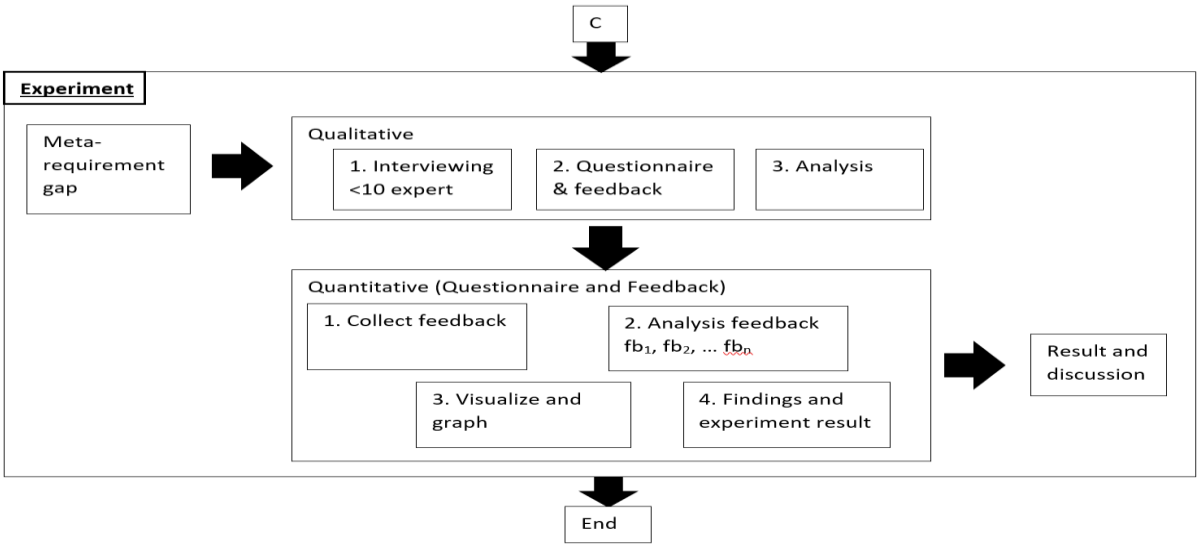

Fig. 4. Research Methodology Flow Chart Part 3

IV. CONCLUSION

By applying meta-requirements during the process of analysing requirements specification completeness should provide us with a more effective method in determining earlier assessment of a software project future. The outcome will be beneficial to the stakeholders that are involved in the institute such as software developer, project manager, OEM, etc .

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