

Critical Proficiencies for Requirements Analysts: Reflect a Real-world Needs

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Abstract: *Requirements Determination (RD) is regarded as a critical phase of software development, In particular, the involvement of human interaction with RD diversity increase of communication issues such as miscommunication, misunderstandings between stakeholders that impact on software projects time and cost. Therefore, the software analysts' communication skills are a key factor in project success. Originally analysts' responsibility is RD tasks, however, due to the variety and the number of tasks that need to be covered, as well as different skills for each task, the sphere of their job is usually extended. This study is explored analysts' proficiencies in requirement determination. An Ethnography method has been used with software Development Company in order to investigate the analysts' proficiencies. Our research design conducted through an interpretive philosophy using thematic analysis data-driven approach. We have found that 18 critical proficiencies are impacting situations in which requirement determination occurs. We propose that the analysts' proficiencies are a set of activities between analysts and users in which requirement determination situations consists of gathering users' initial requirements follow by deeply understanding of the users' requirements. Surprisingly, knowledge of requirements analysis and design solution methodologies including the traditional approach did not seem to be critical proficiencies for requirements analysts. In another hand, knowledge of commercial software and business process for various types of commercial business seem to be one of the most important critical proficiencies for requirements analysts.*

Keywords: *Requirements determination, analysts' proficiencies.*

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1. Introduction

Requirement determination is defined as a set of activities to the gathering, managing, and documenting the system requirements as well as it is a process to establish the agreement protocol between stakeholders about requirements change[12]. Presumably, this process is in excess of gathering and agreeing about software requirements needed for the system to be designed, It also contains goals clarification, perceptions, and needs of users [4].

Therefore, stakeholders must agree to the system requirements. Hence, communication issues and challenges lead to miscommunication and misunderstandings about software requirements, which influence on RD process by increase software projects time and cost. To reduce these negative consequences, efforts must be made to minimize the potential influence of communication issues and challenges between stakeholders' especial analysts and users in order to software requirements being developed[19].

In recognition of these matters, the software analysts' communication skills are a key factor in project success. In the company the analyst responsibilities to present requirements in a simple format in order for the software development team in order to develop them without any previous knowledge or experience of the users' business and business [16].In any organization, the division of tasks,

responsibilities, and activities is assigned to the employees based on the organization's structure, project conditions or personal capabilities [2]. Originally analysts' responsibility is RD tasks; however, due to the variety and the number of tasks that should be achieved, as well as different skills for each task, the sphere of their job is usually extended. Therefore several studies recognize the importance of competencies and role of the RA throughout the requirements determination process. For instead, Ahmed [1]investigated the non-technical skills required for a new employee in a software engineering company. The research was based on 250 job descriptions from four different regions: North America, Australia Asia, and Europe. The results showed that although the non-technical skills for software engineering were more or less same across different cultures, the non-technical skills involved displayed different standards in different world regions. It has been especially evident that the skill that was highly demanded across all four regions was the analysts' communication skills.

However, the understanding of analysts' proficiencies has shortcomings in the literature of requirement determination. According to Klendauer *et al.* [11] noted current research about requirements analysts' expertise has numerous of gaps. Klendauer *et al.* [11] pointed out three reasons behind that first; the researchers have focused on cognitive theory without

real-world settings consideration; in general, communication skills and managing processes have not often been systematically studied, proficiency has considered as experience years in most studies, second reason is there is a be short of research with look upon possible examiner complex task; most studies conducted simple tasks, needs less than two hours to achieve, with outside validity, third reason is there is a need for complex tasks that reflect a real-world needs within context that contain a various constraints.

Therefore this study explores these issues, and we represent findings that answering the following question “What are analysts’ proficiencies in requirement determination?” we have used explaining theory type adopting from Gregor[8]. According to Gregor [8], the explaining theory is appropriated to understanding how-why-when-and-where actions occur. However, that making future predictions is not the main concern.

2. Research Approach

2.1. Design of the Study

The research question: “what are analysts’ proficiencies in requirement determination?” comes from the requirements determination setting and context that an interaction between stakeholders occurs. This research problem is specified that RD is a critical communication activity. An interpretive approach is an appropriate to be conducted, in order to understand participants in study view from real-world context and give a narrative exploration to understand the participant's perception, and in order to understand participants acting and communicating through the RD phase [17].

Ethnography research method is well recognized and generally conducted in a social context. The main principle of the ethnographic method is to give an explanation of team cooperatively, make concentration social and cooperative manner of actions.

Ethnography is a suitable approach for exploring behaviours, communications, attitude, and perceptions that happen within team and companies but are not however obviously understood. Information and knowledge about group social life can be elaborated by ethnographer’s engagement into team life in the organization [13]. The main research aim is to present insights views of requirements determination team interaction through gathering information [9,15].

2.2. Data Collection Methods

Data was gathered in fieldwork. We conducted observation method, interviews. We have been in 30 hours meetings between stakeholders. Both official and unofficial types of interviews were used

At the official interview, schedule discussed with analysts were managed and agreed. This kind of

method helps us to code and identify the related themes and patterns during data analyses. The audio file text and notes taken were used in data analyses. It mostly the researcher engages with participants meaning, in which helping to interpret the text. In coding phase, the data analyses exposed particular themes and patterns that help us to prepare the questions for a second meeting. Van Menan[18] named this protocol as deeply engage with the process. After initializing themes and patterns, we prepare a set of questions for further discussion. The arrangement of next meetings topics and questions were based on the results of the previous interviews. The reason for the meetings was to related themes and patterns from participants’ viewpoint. Our understanding of the connection between themes and patterns was confirmed with participants through providing previous stage analyses to the participants. The main feature of producing a result from the interview was supported by participants’ experience.

2.3. Data Analysis

An inductive approach is conducted that mainly uses exhaustive reading data to obtain themes, patterns, and models. In other words, we start from the study area and generate a theory based on collected data [5].

In this study, three steps of data analysis have been applied. The first step is developing initial codes; the purpose of developing initial codes is to explore and develop an understanding of the events and situations where requirement determination occurs. Developing initial codes helped us when it came to developing a plan for data collection, as the codes assisted the analyst to answer questions related to requirement determination According to Spradley[15] before conducting next interview it is necessary to initial analyses the data collected in which help the research to determine and prepare the set of questions for future interview. Furthermore, Spradly[15] noted that the ethnographic researcher should start his/her data analysis shortly after that begin to collect the data to search for codes and to search for relationships among those codes. Because of this, it is practical to develop initial codes. Since we collected the data for this study from two real organizations, both of them needed me to give a clear plan about from who we would be collecting the data, and when and how we would be collecting the data. This request was reasonable and indicated that neither organization wanted the researcher to slow them down and that they wanted to avoid any possible impact on analysts’ progress. This process of developing initial codes was an on-going process during the data collection. Therefore, we used the concept of theoretical saturation in which there are no new codes generated.

Table 1 shows the initial codes that were generated from the data collection analysis process at this stage

of the study. We used key point coding as a coding strategy.

Table 1. Initial codes.

Circumstance (where)	procedure (when)	Critical Proficiencies (How)	fundamental Explanations (why)
Demonstration	Collect high-level information about requirements	Know the users' issues Know the users' initial needs Write a report	Analysts carry out the demonstration presentation to present the potential products to users Analysts convince the users about product functions
The users accept a product offer	The in-depth collecting of information about requirements	Get more details about the initial needs Use issues list to get further explanations from the users. Discussion and understanding of his/her business process	Solve the users' issues Understand his/her business process

The second step is validating initial codes with participants to confirm and validate the analysis, and second validating the code statistically[6]. Start by validating the code with participants, after developing a set of initial codes from collected data, the second set of interviews were conducted, this step was a regular on-going process within the step of identifying initial codes. This was done mostly in order to reduce any potential threat to the validity of the research, which, as suggested by Frey *et al.* [7,10] validity of the interpretive research can be achieved by increasing the number of interviews which would reflect the participants', rather than the researcher's, perspective. Thus, participants had been invited to focus group sessions and were interviewed (mostly informally). We sent them a report a week before each focus group session to show my interpretations of the data collected. The report covered elements of situations, processes, codes, and reason behind them. In this report, we explained our analysis result from what they had said in interviews and what we had found in field observation in terms of the codes.

found from the data collected. We also encouraged them to comment on our interpretations, particularly to advise if they saw our analyses differently from what they do. None of the participants suggested a change of analysis result rather they gave us more explanation of why they used such codes which helped us to move to identify the themes. Table 2 shows the summary of the codes validation step through focus group session and interview.

The third step of data analysis is identifying themes; the process of identifying themes from the raw data undergoes a coding stage in the first instance[14]. Throughout the analysis process, common themes are identified and coded. A theme is a unit that combines the related data to the research question and is forming a meaningful pattern within a dataset[2]. A theme is emerging after identifying, categorization, and combining several codes under the similar themes and patterns when a process of constant revision and collection of the codes with the same pattern is undergone.

Table 2. Codes validation.

Circumstance (where)	Procedure (when)	Critical Proficiencies (How)	fundamental Explanations (why)
Demonstration presentation	Gathering the users' initial needs	Identifying possible improvements	To convince the users about the product functions. To evaluate the functions modification effort. To manage users requirements. To define product boundary. To achieve users' expectations. To minimize the conflict of expectations.
Sample Quote From Focus Group	"They are not accepted about the product unless they observe what functions of the product and what the outcome, such as reports" "You know? All about business. If I want to pay and need to be convinced about the product, so we create a real - live demonstration for users to demonstrate how to work our product" "... but how long it needs to modify and how much it costs" "... one of the important things is to know our project boundary" "... some functions are taking ages to modify, like, you know, we end up with a new product, and without managing that we will have a problem with users"		
Sample Quote From Interview	You know what, we are trying to know what can be modified and what cannot be, you know, otherwise we will not do our promise to users, so you discuss with users what type of functions that we are going to modify, some modifications need ages to do and it looks like new system we will develop so we need to care about functions modification in order of impact on other functions, cost, and time needs to do all of them.		

In the process of sorting out the codes, some codes become the themes on their own, while some codes act as sub-themes within bigger groups. During the process of code revision, some of the codes will be discarded, while some form a 'miscellaneous' theme due to the fact that they do not fit in any other main theme or sub-theme. The themes' titles appear from the

actual phrases in the data scripts [3]. The Figure 1 presents how themes are identified and formed into codes in the

process of identifying, categorization, and combining several codes under the similar themes and patterns through revision and collecting all the identified codes.

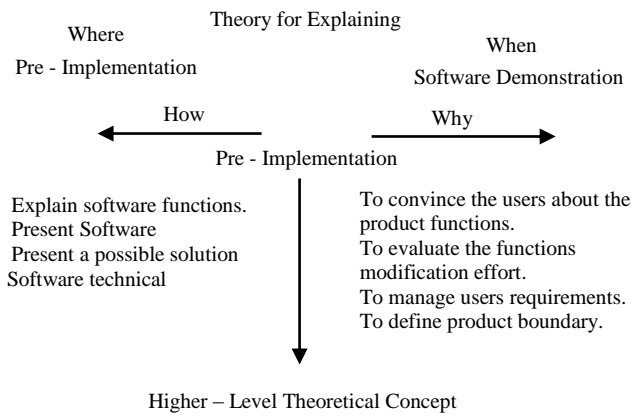


Figure 1. Themes.

3. Findings and Discussion

Our inductive analysis results inform an alternative vision of critical expertise for requirements analysts, by using two main situations where requirements determination occurs; demonstration presentations when analysts collect users’ initial needs, and the time period after the users accepted a product offer when analysts obtain an in-depth understanding of users’ needs. We identified 6 critical of expertise for collecting users’ initial needs and 16 critical of expertise's for getting a comprehensive understanding of users’ needs.

Equation 1 shows an evaluation formula for requirements analysts' critical proficiencies in which critical proficiencies has a percentage impact on requirements determination phase as shown in Table 3 and 4.

$$= \sum_{\text{initial needs}}^{\text{in-depth}} \left(\frac{\text{Requirements Analysts Critical Proficiencies}}{\text{Theme}} \times 100\% \right) \quad (1)$$

The results show those different critical proficiencies are used for the causal purpose during the requirements determination phase. For instance, to help clients create a vision about the product functions, and increase clients involvement and participants is cause for explaining product functionality critical proficiencies under product explanation theme. Given that, our result was perceived causal purpose from requirements analysts' activities perspective.

Based on the percentage results of each critical proficiency found shown in Table 3 and 4, we can see that the high score critical proficiency was an explanation of product features (58%), while the least critical proficiency was a discussion of users’ problems (17%). The second high score critical proficiency was prototyping presentation (45%), followed by linking business process to product functionality (35%) and discovering users’ expectations (22%). The second less score proficiency was identified for potential improvement at 17%.

Table 4 shows the percentage of critical expertise applied by the organization, during the in-depth

understanding phase that used different ranged of critical expertise from 6 % for identifying possible improvements to 25% to get confirmation of process and clarify information.

The critical expertise of facilitators and using explanation tools were the second least applied critical expertise, with a percentile usage of 8% and 7% respectively. Exchanging documents did not have much higher usage, with the result of 9%. The building a relation critical proficiency was applied at a level of 9%, while the acquire knowledge and define users roles (Key Users) critical expertise had a very similar result of 10% and 10% respectively. The discuss progress since the last meeting, review meeting agenda, discover user past experience, and requirements reviews, and critical validation expertise was applied at 9%, 12%, 10% & 12% respectively. The open questions proficiency and describe organization process proficiency scored at 17% and 20%. The second less score applied expertise was a discussion of users’ issues (24%) and in-depth discussion (22%).

Table 3. Initial needsphase: critical proficiencies.

Theme	Code	Usage of Critical Proficiencies By organization
Product Explanation	Explaining product functionality	58%
	Link the product functions to business process	35%
	Prototyping presentation	45%
Define the Scope of Product	Discovering client’s expectations	22%
	Discussing the client’s issues	17%
	Identifying possible improvements	17%

Table 4. In-depth understanding phase: critical proficiencies.

Theme	Critical Proficiencies	Usage of Critical Proficiencies By organization
Requirements Gathering	In-depth discuss	22%
	Discussion of client’s Issues	24%
	Explain business process	20%
	Open questions	17%
	Get confirmation of process and clarify information	25%
	Identifying possible improvements	6%
	Define users roles (Key Users)	10%
	Acquire knowledge	10%
Process management	Requirements review and validation	12%
	Discuss the progress since the last meeting	9%
	Discuss meeting agenda	12%
	Exchange documents	9%
Interaction Management	Building a relation	9%
	Discover users past experience	10%
	Facilitators	8%
	using explanation tools	7%

An interesting research result is that advanced knowledge of requirements analysis and design solution methodologies including the traditional approach did not seem to be critical proficiencies for requirements analysts. A possible explanation could be that analysts have never used or trained on RD tools, and therefore had a lack of knowledge about the

support providing from RD tools to assist their work. Barriers appear that advanced techniques and RD tools are not generally known by the analysts or they are likely to keep away from the attempt of introducing new tools.

In another hand, knowledge of commercial software and business process for various types of commercial business seem to be one of the most important critical proficiencies for requirements analysts. For instead, explaining product functionality has been identified as one of the major factor affecting the analyst's gathering of the users' initial needs. The analysts spoke about how users commonly lacked understanding of product functions within their business. In order for the users to participate successfully in any discussion about their expectations and needs, their involvement needs to be actively solicited. This would require an established description of product functions at the start of the gathering of the users' initial requirements process. The importance of such processes is also indicated by the literature surrounding requirement determination, which suggests that users involvement and participation in the process of RD is a critical factor. Furthermore, Analysts linked between the product features to users' organization process by an illustration of the business cases to demonstrate how product features support the users' organization process. The reason behind that analyst tried to show the essential functions of the product in order to convince the users about product benefits. In other words, in order to help the users to create a vision about the product's features, it is crucial to link the product features to the organization business process.

To understand the organization business process, the analyst created an environment where the users would feel comfortable to take part in a discussion about their own expectations and needs. The analyst encouraged the users to share their ideas and readily involve in the discussion. From the analysts' interviews, it became clear that the description of the product functions with the business process should be specified at the beginning of the gathering process of the users' initial needs. The consequence, Prototyping presentation with some screenshots have been used to show the product features in order to display and convince the users how the product features could suit their organization process and solve any issues in their current organization process.

Given that, the process of prototyping encompasses the construction of a designed system model that helps enhance understanding of the problem and, at the same time, spot the viable external behaviours' for possible solutions. Prototyping defines potential risks in the early stages and is a necessary development tool that analyses and identifies the real requirements while cutting out the unnecessary requirements.

The result from demonstration panel has been used to determine potential improvements that users wanted

for regarding some functions to be adding to the software.

Analysts clarified the potential to improve some features in order to achieve the users' expectation which helped discover the initial requirements of users. The importance of such presentation is also indicated by the literature surrounding requirement determination, where the construction of a designed system model helps increase the understanding of the issues, and concurrently identifies probable solutions.

From the above discussion, it can be observed that discovering users' expectations is essential critical proficiency. The analysts justified the reason for discovering users' expectations are to understand the scope of the product. Understanding and discovering users' expectations helps them to users need and assist them to discuss a problem or a request. This kind of approach contributed to clarify analysts understanding of what they hear and interpret the users' message. Hence, identifying possible improvements is an important critical proficiency that can be achieved by managing dependencies between requirements in the process of gathering the users' initial needs. The reason for this is that customizing the product to suit organization business process is an expensive and time challenging activity. Therefore, in this study, the interviewed analysts seemed to support the idea of the importance of identifying possible improvements on product functionally.

Unfortunately, not all the users' requirements can be efficiently satisfied because of that in some situation a technical and resources constraint. The analysts, however, prepare the priorities in order to clarify product scope, take decisions regarding the requirements that must be complete and the requirements that could be left aside. It is the matter of managing discussion to define the product scope through identification of the dependencies between the requirements. Once the product scope is agreed on, analysts and users set the tasks in order to complete the project.

We compared existing competency models for requirements analysts with our themes and codes to select a model that fits the data well. The best match was the Competency model for requirements analysts by Klendauer *et al.* [11]. This model was derived from an analysis of a wide range of data, gained by conducting 64 interviews at eight Major North American and European financial services companies. The model suggests 16 critical competencies for requirements analysts. These critical competencies provided the basis for my further validation of coded themes. The competencies of the model contained detailed definitions, including behavioural indicators, which were adapted to the role of the RA. However, my coding rule was to not impose existing proficiencies from this existing competency model onto my new data if there was no good match. Tables

and Figures below show the comparison of coded themes and codes with the competency model for requirements analysts provided by Klendauer *et al.* [11] as shown in Table 5.

Table 5. Klendauer *et al.* [11] competency model.

Title	Definition	
Consulting others	Involves key stakeholders (mainly customers, but also developers and RAs) to a large extent early in the decision-making process.	Identifying possible improvements
Testing assumptions and investigating	Clarifies vague or inconsistent information, and questions statements and assumptions. Identifies and detects problems. RA is not intimidated by business language and complex formula and does not hesitate to check with the customers about business aspects the RA is not familiar with.	Discovering client's expectations
Explaining concepts and opinions	Clearly explains the logic of a concept in a simple way. Summarises key points of the SRS. Explains why the recommended concept is the best solution and how it is going to look like.	Explaining product functionality Link the product functions to business
Driving projects to results	Works in a goal-oriented way. Keeps in mind that creativity is desirable but not without any limits, and focuses on the minimum necessary to reach project goals.	Identifying possible improvements
Gathering information	Gathers relevant and complete information and documents them. Uses a range of sources (e.g. intranet, documentation, observation, interviews, and prototypes).	Prototyping presentation Discovering client's expectations Discussing the client's issues
Focusing on customer needs and satisfaction	Is responsive to the wishes of the customers and understands their (unexpressed) needs. Takes into consideration the daily activities of the users.	Discovering client's expectations Discussing the client's issues
Applying technical expertise	Shows detailed job knowledge and expertise, and uses specialist skills in own work (e.g., knows how to ask questions and draw use cases).	Link the product functions to business
Producing solutions	Produces a workable solution independently, taking into account relevant needs and constraints.	Identifying possible improvements
Shaping conversations	Actively guides the course of conversations	Explaining product functionality Link the product functions to business process
Taking action	Takes measures without hesitating too long. Takes preliminary steps to do what needs to be done without direction.	Identifying possible improvements
Targeting communication	Writes SRS in a structured way and avoids technical jargon. Communicates with each stakeholder group at an appropriate level.	Product Explanation
Gaining agreement	Gains agreement among customers or between business and IT. Makes each party feel that their individual needs were reacted to and that the agreement is fair and not.	Identifying possible improvements
Analysing and evaluating information	Identifies key relationships within and between systems, relevant patterns and effects at both high and detailed level of analysis.	Identifying possible improvements

4. Conclusions

Overall, our research results emphasize the dual importance of both social and analytical proficiencies. Nevertheless, precise balancing of these critical proficiencies seems crucial for the effectiveness of an RA.

Analysts' social and analytical are key factors in project success. 18 critical proficiencies for requirements analysts have been found in which impacting by situations of requirement determination occurs. We propose that the analysts' proficiencies are a set of activities between analysts and users in which requirement determination situations consists of gathering users' initial needs follow by deeply understanding of the users' requirements. At the gathering client's initial needs, critical proficiencies such as explaining product functionality, linking business process and product functionality, and prototyping presentation in which help the analysts to gather users' initial needs in order to prepare for in-depth understanding. At the comprehensive understanding stage, various critical proficiencies have been applied by analysts such as open questions, explain a business process, in-depth discussion, requirement reviews, acquire knowledge and exchange documents. Consequently, looking to improve analysts' proficiencies during RD processes should have a positive impact on the effectiveness of the RD process.

The limitation of the study is that the results source comes from analysts' perspective without users/ users' perspective. Future work will be by adding more detail to the adopted model through exploring the most used critical proficiencies by analysts as well as by exploring communication media and tools utilized for these critical proficiencies.

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