Saint Petersburg State University Graduate School of Management

**FRAMEWORK FOR BUILDING ENRICHMENT SYSTEM IN MOBILE BANKING FOR MERCHANT CLASSIFICATION**

Master in Management

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ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ

ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

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\_\_\_\_31.05.2022\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Дата)

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\_\_\_31.05.2022\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Date)

**Аннотация**

|  |  |
| --- | --- |
| Автор | Пушкин Артем Алексеевич |
| Название магистерской диссертации | Фреймворк для построения системы обогащения классификации продавцов в онлайн-банкинге |
| Факультет | Высшая школа менеджмента |
| Направление подготовки | Менеджмент |
| Год | 2022 |
| Научный руководитель | Страхович Эльвира Витаутасовна |
| Описание цели, задач и основных результатов | Разработка программного обеспечения и инновационных технологий в банковской среде позволяет получить конкурентное преимущество перед другими банками. Одним из основополагающих аспектов разработки программного обеспечения является создание требований. Существует множество научных работ и методологий посвященных созданию требований, однако не существует единого шаблона, который бы помог эффективно создавать требования в любом организационном контексте. Среда создания требований и суть проектов очень различаются в зависимости от индустрии и типа организации. В связи с этим, существует необходимость создания фреймворка, который бы учитывал особенности создания требований в банке, и благодаря которому практики смогли бы более эффективно создавать требования к ПО. В этой магистерской диссертации создан фреймворк, который описывает процесс создания требований в банковском контексте исходя из опыта практиков. В работе произведен анализ восприятия практиков процесса создания требований, включены ключевые стадии и проанализированы аспекты, влияющие на создание требований. На основе анализа даны рекомендации по применению наиболее полезных техник и методов в банковском контексте. Фреймворк был применен и протестирован на реальном примере из банковской отрасли, на создании системы обогащения классификации продавцов. Фреймворк показал повышение эффективности при сокращении времени на сбор и создание требований, а также сократил количество итераций. |
| Ключевые слова | Разработка требований, менеджмент требований, фреймворк, повышение эффективности процессов. |

# **Annotation.**

|  |  |
| --- | --- |
| Author | Pushkin Artem Alekseevich |
| Master thesis title | Framework for building a merchant classification enrichment system in online banking |
| Title faculty | Graduate school of Management |
| Main field of study | Master in Management |
| Year | 2022 |
| Academic Advisor`s Name | Strakhovich Elvira Vitautasovna |
| Description of the goals, tasks and main results | The development of software and innovative technologies in the banking environment allows to gain a competitive advantage over other banks. One of the fundamental aspects of software development is requirements development. There are many academic papers and methodologies devoted to requirements development, but there is no single template/framework that will help to create requirements effectively in any organizational context. The environment for creating requirements and the nature of projects varies greatly depending on the industry and type of organization. In this regard, there is a need to create a framework that would consider the peculiarities of requirements development in a bank, and practitioners would be able to develop software requirements more effectively. This master's thesis created a framework that describes the process of requirements development in a banking context from the experience of practitioners. The paper analyzes the perception of practitioners of the process of requirements development, includes key stages and analyzes aspects that affect the creation of requirements. Based on the analysis, recommendations are given on the application of the most useful techniques and methods in the banking context. The framework was applied and tested on a real case from the banking industry, on the creation of a merchant classification system. The framework has shown an increase in efficiency while reducing the time to collect and create requirements and reduced the number of iterations. |
| Keywords | Requirements development, requirements management, framework creation, process efficiency improvement. |

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# **1. Introduction.**

##

## **1.1. Background**

The development of the mobile application encouraged traditional industries to follow a technological path, banking is not an exception it is going towards adapting its services inside the uniform banking application for several years. The competition among banks influenced the advancement of the financial technologies used in bank applications, making them a better fit for the users.( C. Lee, X. Li, C. Yu, J. Zhao, 2021 )[[1]](#footnote-1) Indeed, the user experience plays a huge role in application success, banking apps are no exception in that sense.( Sharma, S.K , 2019)[[2]](#footnote-2) Today, in huge corporations every pixel should have the necessity to exist, to attract new and save the current audience. Therefore, features of the app should have clear competitive advantages; fewer errors, greater accuracy, improved communications, increased efficiency and productivity, and more efficient controls- all of that may be attained through quality features.

History of operations is one of the features in banking applications, which directly corresponds to user experience. In that feature, users can check the transactions, at which date they happened, and to which brand they refer to. Compared to other features, the history of operations does not directly encourage sales of products of the bank but allows a bank to retain users and positively affects user loyalty to the brand of the bank. Needless to say, the user experience in that particular feature is very important for the business. The history of operations should be presently looking and be responsive to user requests. The generation of digital-savvy consumers requests the fastest, the most accurate, and the visual appealing experience with an easy-to-use interface.

To create the mentioned system and others, the method of creating requirements for software and systems is used in the bank and in many other organizations. Creating requirements allows to describe the necessary functions of the system. “A requirement engineering process is a structural set of activities, which are followed to derive, validate, and maintain a system requirements document.” ( K. Curcio, T. Navarro, A. Malucelli, S. Reinehr , 2018).[[3]](#footnote-3) However, in each organization an individual project needs to be adapted the requirements development process accordingly, thus requirements management becomes a task that must be faced by the product manager, business analyst, project manager or other person responsible for developing and managing the requirements.

##

## **1.2. Problem discussion**

Recently, the banking sector has been developing rapidly along with the development of new financial technologies.( Arner, Barberis, & Buckley, 2015)[[4]](#footnote-4) More new and more complex technologies are needed to be developed. The problem is that there is no optimal process for collecting and managing requirements in the context of software development in a banking environment. Especially because banking informational systems are very complex. (M. Georgescu, V. Jeflea, 2015) It is agreed that there is no template for developing and managing requirements for every system (K.Wiegers, 2004), the requirements development process needs to be tailored by a person responsible for that task. Also the requirements development in agile software developments is a topic under discussion and many vague points are present due to its novelty.( K. Curcio, T. Navarro, A. Malucelli, S. Reinehr , 2018)[[5]](#footnote-5)Moreover the agile methodology itself poses many issues associated with software development that are related to documentation, communication, user involvement, working environment.(C.Juyun, 2008)[[6]](#footnote-6) Therefore, the software development might be at risk of prolonged release time, more defects and unsatisfied stakeholders, and even lawsuits( Ebert C , 2018)[[7]](#footnote-7). Thus, we can see a clear need to address the business challenges of improving productivity as well as contributing to the industry-specific requirements development agenda.

Motivated by that perception, we conduct the case study research to solve the problems of requirement development life cycle in banking context, by identifying the necessary areas of improvement using the case of merchant classification system development. Overall, the managerial decision-making framework will help practitioners to develop necessary software more efficiently, describing the necessary stages and proposing techniques. The theory will be enriched with case of merchant classification development, with expert’s view on requirements development life cycle in banking.

Also, the area concerning the user involvement in requirements development is vague, the concept is still underdeveloped. ( Millerand, Baker, 2010)[[8]](#footnote-8) It is also unclear how user involvement in requirements development affects the success of the project, as some authors point out that user involvement can be detrimental to the project. (Brodbeck, 2001; Heinbokel, Sonnentag, Frese, Stolte and Brodbeck, 1996).[[9]](#footnote-9) We will enriches the area of user involvement studies and management with a case of online banking organizational context.

## **1.3. Purpose**

The purpose of this work is to create a managerial decision-making framework for developing requirements for a merchant classification system and similar internal systems in banking environment based on perceived value of stages and suitable techniques.

## **1.4. Contribution**

The contribution to the research field could be divided into theoretical and practical areas. On our part, the work is intended to enrich the theoretical field with a case study of the development of merchant classification system. The perceived value of various stages of requirements development in banking is assessed by practitioners, various organizational features are defined, and their value is stated. Moreover, to the theoretical part, the importance of creating a decision-making framework configuration should be noted, this will complement the field of management with one of the approaches to adapting the requirements development framework with suitable techniques and approaches. The issues of software development in banking will be covered in the paper. The analysis of the stages in requirements development process present in the paper.

As for the practical implications, the created framework will be a guide for responsible for the project person to adapt the requirements development and effectively build needed system in banking environment. Especially novice practitioners will find the work valuable, when facing the problem of order of requirements development in banking. As for business, the framework allows to develop the system in a shorter time, thereby reducing the time to market. Additionally, the framework showed to reduce the number of iterations of requirements validation with stakeholders, thus saving precious time of individuals. The framework allows a more consistent system configuration, which in turn will allow managers to adapt and improve the system to give customers an improved user experience. For the organization, the effective implementation and use of the system will allow a bank to gain a competitive advantage over other banks and directly influence the user experience.

## **1.5. Relevance**

The relevance of the study is justified by the need to find ways to improve software development process. The software development in the organization is one of the most import aspects of the innovative strategy and an opportunity to gain competitive advantage. Innovativeness of services rather than physical products is the way to increase competitiveness (T. Hong, C.B. Cheong, H. S. Rizal , 2016).[[10]](#footnote-10) Services, which could be improved by the usage and adaptation of our decision-making framework may be the way to bring more value to customers. Therefore, the relevance of the research is proven by the importance of identifying ways to increase user satisfaction, the user-perceived value of the application, by advancing the process of requirements development and consequently the product itself. The organizations thrive is closely linked to building quality long-term relationships with customers, the right communication is an integral part of transferring an intended message. Services and products provided by an organization are also translating the message to the customer since the excellent experience leads to improving overall satisfaction with the brand and organization. Right marketing and services help an organization to attract new and retain existing customers (Rowley, 2016).[[11]](#footnote-11) Increasing the loyalty of the customers has proved itself to be a more significant and more profitable metric than to acquire new ones (Ahmad et al., 2011).[[12]](#footnote-12) Therefore, we can state that the relevance is provided by the need of increasing efficiency of the requirements development process in banking environment, which leads to better user experience and competitive advantage over other banks.

## **1.6. Delimitations**

We tried to get a complete understanding of the requirements development process in particular type of environment. Although there are plenty of research articles dedicated to requirements building, all the theories could not be included in the research. Therefore, the ones considered as the most important within the field have been examined. Also, not all of the banks with different structures included in the research, the means of reaching to employees of many banks is limited. The focus of the study is limited to one major bank in Russia, which gives a narrow look on the problems identified.

The case study is limited to only one system in concrete banking environment, banks which have completely different business rules need to adapt given framework. Thus, the case study might be used to compare and adapt the framework. Also, it is needed to test the framework in other banking environment to test its validity. But we are sure that in the case when the information is not easily attainable, the precise measurements are not available, the incorporation of practitioners view and case study serve as an acceptable approach and ensures validity.( Helmer O., Rescher N.,1959)[[13]](#footnote-13)

Moreover, the qualitative incline of the work in methodological part could bring ambiguity and imprecision. This issue is present in various other research linked to requirements management process.( Demirel S.T, Das R., 2018) [[14]](#footnote-14) Differences in perceived questions and sematic meaning, the context perception could incorporate imprecision as well.

# **2. Frame of references.**

The main concepts to shape the research are concerned with two theoretical realms, the requirements development and management[[15]](#footnote-15), and organizational context theories. Covering those theories will help us understand the needed gaps to be discovered.

The area concerned with requirements development has different connotations, some authors call it requirements engineering (Sommerville и Kotonya, 1998), and some requirements management (Leffingwell и Widrig, 2000). We would divide the area into requirements development and requirements management, we will be concerned with both requirements development and requirements management (Karl E. Wiegers, 2004). Since our framework will incorporate not only the part when we develop requirements, we will also consider techniques and methods to manage requirements when risks are present. Requirements development includes such things as elicitation, analysis, specification, and validation.

## **2.1. Requirements creation process.**

In his classic book, Requirements Creation, Wiggers(2003) argues that there is a top-level process for creating requirements. It has already been identified and begins with the fact that the analyst identifies the requirements from the stakeholder or user, then the information is processed, classified, and correlated with the requirements, then the requirements are written in the form of documents, and finally, give the document for verification. The diagram is shown below.



Figure 1. Requirements development process.(Wiegers K., 2003)

We will follow the guidelines presented above with adjustments to a template and a more rigorous explanation of various phases. The above process is universal to requirements development, but it does not consider the details which are related to different organizational contexts. This is very brief introduction to requirements development, but to understand the nature of the requirements development it is enough. We should only highlight the ground of the requirements development, since it will serve us as a basis for our own framework. The cyclic nature of the requirements development is also present in our framework.

## **2.2. Requirements management.**

Actions concerned with requirements management include:

1. Defining the priorities of the requirements
2. Reviewing proposed changes to requirements and evaluating the likelihood of impact of each change before it is accepted
3. Incorporating approved requirements changes into the project in a specified manner
4. Alignment of the project plan with the requirements
5. Discussion of new commitments based on the assessed impact of changing requirements
6. Trace individual requirements to their design, source code, and test cases

In his work, Carl Wiggers argues that the primary interaction with users is necessary for the quality collection of requirements. The time that was spent on clarifying the requirements of the user is a very high-quality investment in the future of the project. However, Wiggers notes that it is impossible to fully define the requirements the first time, very often you have to resort to the prototyping phase of the system or software. The cost of a mistake increases later in development because the investment that was invested in the project before the error, such as code testing, will exceed the investment that was invested in the requirements gathering phase (Grady, 1999). Therefore, iterations are needed, with the constant refinement of requirements from stakeholders and users.

Also, it should be noted that one of the most difficult actions is the definition of requirements. A clear goal setting, definition of a business problem, and constant communication allow you to identify the requirements most accurately. A clear understanding of the requirements, understanding the purpose of the product or project gives confidence that the project team is moving in the right direction and focused on the necessary goals and objectives.

Another important aspect is the involvement of users in product development. This should be done primarily for new projects that have many risks. Various interview techniques and contact with clients through special feedback collection systems allow you to get the necessary information. Very often, those responsible for the project overestimate their own knowledge of the client and make mistakes, which leads to an inevitable delay in the completion of the project. An alternative to communicating with users is to view statistics, refer to previous customer data, and follow the example of competitor companies. It is worth saying that these techniques can save a lot of time when the release is the priority and the significance of the project for the system is not critical. Such high-risk techniques should be applied by managers with extensive experience since intuition will be the main quality here.

Regarding the ambiguity of the interpretation of the requirements, this is the situation when the written requirements are misunderstood or can be interpreted in several senses. This often leads to requirements being misunderstood during the development or design phase, leading to delays or errors in the project. A common way to avoid ambiguity is to invite outsiders to review and get feedback on the clarity of the requirements.

## **2.3. Banking industry features in software development**

When developing requirements for a product there is integral influence of the external environment on requirements, it could be hard to assess. And in banking context external influence could reach to the systems of the bank, for example financial systems(V. Y.Gulevaa, A. Dukhanov; 2015)[[16]](#footnote-16), or the banking software[[17]](#footnote-17). Banking is highly competitive industry with need for overdo its competitors, thus the provision of benefits of customer service is essential to make the client more comfortable and provide value.( Giovanis et al., 2019)[[18]](#footnote-18) The benefits of innovative banking are easily recognizable. Digitally banking is presented by mobile application or internet bank. This way we can detect the link between IT and banking sphere. The hallmarks of the banking industry are present at the intersection of banking and IT.

One of the features of banking in the case of software development is intellectual property rights. The products and services provided by the bank are in the public domain almost immediately and are not protected by intellectual property rights quite often when it comes to innovative technologies.[[19]](#footnote-19)[[20]](#footnote-20) As a result, banks must understand that once an innovative technology has appeared the market, competitors will be able to replicate it. For the requirements process, this may mean that the overall look and feel of the product is known and there is no need to develop it from the scratch. If the the product is copied from a competitor, then the need for many procedures when creating requirements is called into question.

Another feature of developing systems for a bank is a special attention to security, trust and confidentiality issues. In fact, security issues pose one of the major concerns of adopting online banking.( Abu-Shanab, E., & Pearson, J., 2007; Y.K. Dwivedi, 2014)[[21]](#footnote-21)[[22]](#footnote-22)The evident risks associated with relatively new technology scaring away cautious customers.( S. Yousafzai, 2012) [[23]](#footnote-23)Also, the cultural settings influence the security consideration among different cultures(A. Tarhini, M. El-Masri, M. Ali, A. Serrano, 2016)[[24]](#footnote-24), the motivations and feelings perceived differently, therefore the security issues are linked to past experience of the user, the user’s psychological characteristics. Therefore, while developing requirements, one should consider social and cultural norms which correspond to security and privacy issues.

Importance of the banks to the financial system is also a feature characterizing the banking industry. Some banks are even more important to the global financial stability, posing systemic importance. Daily life and opportunities of many people are linked to their banking actives, which place an even more importance on banking industry in social contex. Banking is beneficially influence the economic growth of the society in the short and long run.( P. Klein, L. Weill , 2022)[[25]](#footnote-25)It means that banks can affect the vulnerable assets of people, affecting their psychological state. Therefore, the perceived importance and image of the banks could affect user during interview. Organizational image influence both external customers and internal workers (Frandsen S., 2017)[[26]](#footnote-26), making the effect double.

Banking systems are often connected to many other internal systems, which bear a high level of complexity. ( Wijnhoven, 2009)[[27]](#footnote-27) Banking institutions have a wide range of business tasks to deal with, which require the best possible solutions to manage the financials, organizational management, international relations, marketing operations etc. Also, with increased flow of automation of banking operations, which could be provided via mobile banking, ATM machines bring more data and complexity. Thus, with increasing complexity of tasks the informational systems of banking should evolve accordingly to provide the appropriate service. Given that the informational systems in banks are complex, which ensure the obtaining information, throughout collection, manipulation, process, storing, organization and distribution activities, in order to assure decision support to accomplish organizational objectives (M. Georgescu, V. Jeflea, 2015)[[28]](#footnote-28).

Therefore, we can state that the hallmarks of the banking industry are the following: 1) Peculiarities of intellectual property rights

2) Special attention to security, privacy and trust from customers

3) Importance of the banks to the financial systems, which lead to special perceptions concerning the banking industry

4) Complexity and interconnectedness of banking systems

## **2.4. Organizational context theory**

### **2.4.1. Organization influence on requirements development**.

The organizational context, in this case, is defined as the internal and external processes that can influence the development of system requirements. In the case of requirements, the most obvious influence is the organizational processes that affect the requirements development process. Accordingly, it is important for us to identify the most obvious processes in the banking sector that can influence the development of requirements. It is also worth stating that agile approaches are not that different from traditional ones in terms of requirements development and management (F. Paetsch, A Eberlein, F Maurer, 2003) the organizational processes are present in both approaches which somehow influence the development phases, for example the documentation of requirements part is highly significant in both approaches.[[29]](#footnote-29)

We had also conducted a systematic literature review to get an understanding of the banking organizational process linkage to requirements development. We did the research mainly in ScienceDirect and our research terms: “banking” AND “requirements development” in the “article title, abstract, keywords” section. The results of the review are summarized below at the table 1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| № | Influence on requirements | Category | Description | Source |
| 1 | An organization sets goals for a product; therefore influence is huge | Organizational aims | The organization sets goals and explains why these goals need to be achieved. Therefore, the organization is the primary source of requirements. The impact on requirements writing is huge. | Wiegers (2004) |
| 2 | Organizational conditions influence human actions  | Organizational conditions | Organizational conditions influence human actions, technology is a creation of human action as well as requirements for it | (Orlikowski, W.J, 1992)[[30]](#footnote-30) |
| 3 | Requirements specification happens in the organizational process | Organizational conditions | Requirements specification ismainly a social interaction between people, which happens in an organizational environment. A central aspect of the organizational dimension is process management. | (F. Belfo, 2012)[[31]](#footnote-31) |
| 4 | An organization sets strategic objectives which should be aligned with the product | Organizational aims | Stakeholders ofan organization may have long-term goals in terms ofmarket share and so forth. The goals and strategies at the organizational level willinevitably influence which products an organization ought to develop. Requirements posed on products must first be evaluated at an organizational level toensure that they are aligned with the goals and strategies of the organization. | (Aurum, A., Wohlin, 2005)[[32]](#footnote-32) |
| 5 | Business rules set constraints on requirements development | Business rules | Business rules are not software requirements because they are outside the boundaries of any software system. However, they often impose restrictions, defining who can perform particular use cases, or dictating what functions a system must have, subject to the appropriate rules. | (K.Wiegers, 2004) |
| 6 | Organizational influence on requirements has its unique set | Organizational conditions | Organizational influence can be in the form of marketing, internal politics, technical policies, and internalstandards. Companies have a unique mix of culture, purposes, values, and goals. | IEEE Guide for Developing System Requirements Specifications (1998)[[33]](#footnote-33) |
| 7 | Organizations set different types of constraints on requirements  | Organizational conditions | There are generally 5 types of business rules: 1) Facts2) Constrains3)Action enabler4) Computations5) Inference | (K. Wiegers, 2004) |

Table 1. Results of the systematic literature review on requirements development and organization.

Source: [authors research]

We could see how in the academic environment to evaluate the impact of the organizational context on the creation of requirements. We can highlight several common themes.

It is obvious that in any organization and company there is a set of rules, industry standards, and laws that must be followed. The control of these rules is determined by the people and laws of the country in which the company operates. In general, the organizational context is divided into such variables as culture, purpose, values ​​, and goals. We can understand that the system of rules in an organization is a defining variable that determines the degree of freedom and capability that a system must have to be successfully tested and implemented in an organization. It often happens that when developing requirements, it includes restrictions on legislative principles. For example, the system for processing personal data of customers about payments must pass the appropriate security tests and meet the requirements for security and data flow at the legislative level.

It follows that rules within an organization are certainly a value that must be documented. Otherwise, the rules will be interpreted differently, which can lead to problems. Organizations often have their own common document, which contains all the necessary business rules.

Rules within an organization are needed to facilitate the progress of a process and to unify and control operations. There are separate methodologies for creating these kinds of rules (Ross, 1997; von Halle, 2002). When creating a new product, it is necessary to determine the rules that are appropriate for the system and follow them.

### **2.4.2. Types of business rules.**

Based on Wiegers analysis(Wiegers K., 2004) there are different types of rules that affect requirements development in different ways. There are five types: 1) Facts, 2) Constraints, 3) Triggers, 4) Calculations, 5) Conclusions.

*Facts* are statements about existing business processes in an organization that describe important relationships between business processes. Facts often come from the mission of the company and the rituals that have developed in it. Facts affect the development of requirements directly, influencing the description of possible paths. For example, when buying plane tickets, the cost of tickets is not refundable if the buyer decided not to fly and did not report the cancellation of the flight 4 hours in advance. Such a path will be considered when developing an appropriate system.

*Constraints* - define the boundaries of the use of the system by certain users and the processes that the system can perform. For example, when defining a brand, the system can use the rules stored in a certain database and in no other database. Constraints help define the scope of a project.

*Action enablers* are rules that are activated on the occurrence of some action or point in time. These can be both rules automatically reproduced by the system, and rules that are reproduced by people on any trigger. For example, the system can send notifications about violations and delays in the approval of requirements, or a person knows by a certain date that it is time to approve the document.

*Inferences* are rules that come under some conditions. For example, if a person has not received an order within 5 days, then the order is considered unfulfilled.

*Computations* are rules based on calculations. They are not much different from other rules, their main property is to define the rule in numerical form. For example, if the discount on a product is more than 50%, then additional discounts do not apply. This affects the development of requirements in that these rules must be reflected in numerical form.

It is worth noting that some of these business rules may be created during the course of the project and the team will determine the boundaries of these rules on their own. Considering that the requirements are written in the context of the organization, it is necessary to determine which of the existing rules relate to its product, which ones need to be implemented in it and how exactly. The stated business rules need to be analyzed and put into the framework, when considering configuration of organizational influence.

We have identified different types of business rules. With this information we can configure the framework domain concerning business rules and conceptualize it to different parts. The framework adaptation during requirements development should be considering these business rules and identify and prioritize the most crucial ones.

## **2.5. User behavior in mobile banking.**

A lot of research has been done to understand the role of user experience, user satisfaction, loyalty intention and other variables that help understand user behavior.(A.K.Kakar, 2018; Liébana-Cabanillas et al., 2014; Tahir M.Nisar, 2016) [[34]](#footnote-34)[[35]](#footnote-35)[[36]](#footnote-36)The importance of user loyalty in banking cannot be underestimated. Loyalty is created through a combination of various factors, such as: perceived product superiority, personal fortitude, social bonding, and their synergistic effects.( Oliver, R. L, 1999)[[37]](#footnote-37) The user is directly involved in the development of requirements, this approach is used by many organizations and is recognized as effective for a success of projects.[[38]](#footnote-38) However, it is important for us to understand how the user influences the creation of requirements in the banking environment and how user involvement should be managed for the most productive result. In the financial sector, it is very important to pay attention to user-centric products that can provide the most enjoyable user experience. It should be understood that user loyalty should be achieved by improving perceived usefulness of service, satisfaction with initial service.(A. Bhattacherjee, 2001)[[39]](#footnote-39) We need to understand how users can give the most complete feedback on a banking product in order to manage requirements effectively in the future. As we could see earlier, the utilization of feedback from the user occurs due to the need to clarify or test the requirements. It happens at elicitation phase and throughout the project life cycle. Of course, user resource and feedback management at the stage of requirements development and testing can be considered as knowledge management. Knowledge in this context can play the role of a serious competitive factor in such a market as the financial one. There is evidence that effective knowledge management can be a critical factor to drive product collaborative design evolution. (L.Zhen, 2012)[[40]](#footnote-40) User feedback can be seen as the creation of personal knowledge during development activities that are collected, processed and then documented. In this sense, the user can be either in the quasi-role of a team member or perform exclusively the function of creating and transferring personal knowledge. It often happens that the user does not know what functionality he needs, and how to choose the most successful one from different options. The uncertainty factor of user feedback can be a key risk factor for a project and lead to unsatisfactory results.( M. Keil , 2002)[[41]](#footnote-41) In addition to this risk, often indicate the risks associated with a misunderstanding or conflict between the developers and the user regarding the requirements.[[42]](#footnote-42) In order to obtain information on how to utilize user involvement in requirements development, it is necessary to establish a dialogue between users and the people responsible for developing requirements. To successfully establish a dialogue, some preconditions must be set. There are preconditions that are distinguished to be a common frame of reference, it includes the psychological aspects of subject of the interview, experiences as well as increased awareness and critical thinking. (Garmer et al., 1995)[[43]](#footnote-43) Ultimately, the users and the people who develop the requirements need to understand what the problems is with the requirements and the product and how to improve it.

There are ways to conduct the elicitation of requirements, the methods include brainstorming, interviews, observations, and questionnaires(Haines, H.M., Wilson, J.R., 1998) in their different forms and configurations.[[44]](#footnote-44) It is worth noting that in academia and among practitioners (Ginzberg, 1981), it is a common judgment that users who are involved in the project from the very beginning will be more critical of the requirements for the product, will be more involved in the development, will have a better understanding and experience with the product( Ginzberg, M. J. ,1981).[[45]](#footnote-45) In terms of user engagement, there are various factors that affect the degree of it, such as organizational context, psychological characteristics of the user, level of product awareness. Individual variables that affect user engagement should be considered deeply.

We can see that the inclusion of the user is considered beneficial by most of the academics. Therefore, we will consider how do practitioners perceive user participation in banking context. Whether it beneficial or not.

### **2.5.1. Psychology of user.**

User psychology in our case refers to all the personal characteristics and emotions of the user that can influence the development of requirement. Emotional and psychological responses from the user that can lead to a certain response or behavior occur during the interview, during the observation, or may take place before the start of the interview or observation, as a residual effect. (Thew, S., Sutcliffe A., 2008)[[46]](#footnote-46) An important aspect in psychology when conducting experiments or testing a product is the aspect of the influence of the success of achieving a particular goal. If a person was unable to easily complete an action with a product, they may take it personally as a personal failure. (Sutcliffe, A.G., Fickas, S., Sohlberg, M.M , 2006)[[47]](#footnote-47) This behavior of users is complicated by the possibilities of control; however, experienced business analysts are able to manage human emotions in order to avoid bias from this effect. This is just one example of the psychological and emotional impact on requirements development.

From the point of view of psychology, personal goals should be taken into account in the development of requirements. For the assessment of personal goals, two theories of psychology are relevant (Alistair G. Sutcliffe, 2014): 1) Theory of motivation; 2) Emotions. Motivation theory looks at what drives individuals to achieve their goals, while emotion theory looks at how a person reacts to certain events and environments.[[48]](#footnote-48)

There is an opinion(Norman, D.A, 2004) that it is critical for a successful product to have a high level of aesthetic parameters of the product, as this greatly affects the emotions and cognitive work of the user.[[49]](#footnote-49) The ease of use and performance of a product is a very important aspect for the psychology of the user, they are of key importance regarding the nature of the feedback. We can say that when engaging with the user, special care should be taken to separate the response to design from the response to ease of use; in order to better understand the user.

It should also be noted that emotions have manifestations in the user's facial expressions and gestures. Fundamental life tasks are very similar in different people and lead to reactions such as feeling of accomplishment, of failure, lose etc.(P.N. Johnson-Laird, K.Oatley, 1987)[[50]](#footnote-50) It is worth noting that emotions arise not only between people, but also when a person is left alone. For example, a reaction to a weather event, or in our context it is a reaction to a product by the method of observation. Such reactions, which can be called basic emotions(Ekman, P., 1999), are also subject to the user's past experience, both inherent in each person and unique subjective experience.[[51]](#footnote-51) Such basic emotions can be read through the user's facial expressions and gestures. This can make it possible to distinguish a person's real reaction from a socially acceptable one. It should also be noted the versatility of reactions to certain actions. It is impossible to fully predict what kind of reaction will follow on the presentation of the product and on certain conditions, however, it is possible to classify the general basic reactions at the top level. OCC(named after the initials of the 3 authors -Ortony, Clore, and Collins) model (Ortony, A., Clore, G.L., Collins, 1988) can help to classify various reactions of users, the decision tree is presented in figure 3 below.



Figure 2. OCC model.

User motivation is very difficult to identify. Motivation is influenced by the internal qualities of a person, his/her past and his/her expectations from the product. Based on the one of the renowned motivations theories, Acquired Needs Theory (McClelland, D. ,1961)[[52]](#footnote-52) people have three types of needs, based on their previous experience. Those motivations are need for achievement, need for affiliation, and need for power. The need for achievement comes from the motivation of task completion. In requirements development those people are highly valued, because of their demand to demonstrate creativity and innovation. Need for affiliation refers to person’s incline towards building and maintaining relationships, they value how they look in other’s eyes. In requirements development process those types of users are not vary valuable, they tend to hinder they real emotions and feeling about the product to show the respect to the company, or person and make a good impression of interviewer. The need for power is associated with motivation of ability to control and influence others. Those users are practical, assertive and involved. In requirements development they could be too assertive and try to control the situation, so experienced interviewer should be able to get the necessary information. Those individuals are valuable, but it could be hard to manage the process.

We have seen that psychology of user may take very different forms, we identified factors influencing user behavior, which could be used during requirements development and management processes. The ability to control user behavior is limited, but it is achievable by experienced individuals. The theory of emotions suggests that visual representation plays an important role to receive quality feedback and to stay involved in the product. Such theory could be used not only to users, nut to stakeholders and team members when validating requirements. Emotions are pretty similar among human beings and could be easily categorized, which may help us with tracking the hidden feedback in elicitation phase. General reactions are presented above, and can be used during feedback gathering. Motivation theory suggests us to take particular people to gather information, we can classify good options to be people who need power and achievement in their different mixes.

### **2.5.2. User involvement**

User involvement could be described as psychological state of an individual, reflecting the importance and personal relevance of an object or event(Barki, H., Hartwick, J., 1989).[[53]](#footnote-53) Or the depth of user’s investment when using the product (O’Brien, 2016).[[54]](#footnote-54) In requirements development context user involvement means the psychological state and importance that user puts to the product. The concepts covered in user’s psychology part are somewhat related to the user involvement, but distinct since motivations in both cases could be the same. Personal involvement level could be categorized (Bloch and Richins 1983; Houston and Rothschild 1978)[[55]](#footnote-55) to 1) Personal—inherent interests, values, or needs that motivate one toward the object; 2) Physical—characteristics of the object that cause differentiation and increase interest ; 3) Situational—something that temporarily increases relevance or interest toward the object. Lately, the agenda of user involvement could be considered in depth with newest technologies, which could spot different signals concerning user involvement. Computer-based systems may detect the facial expression analysis, speech analysis; neuro-physiological signal processing methods, e.g., respiratory and cardiovascular accelerations and decelerations, muscle spasms; and web analytics, e.g., number of site visits, click depth.[[56]](#footnote-56) But user involvements is highly context dependent(H. L. O’Brien, P. Cairns, M. Hall; 2018), therefore the user involvement motivations to participate in the requirement development and duration of involvement vary. [[57]](#footnote-57)

There are various theories that suggest ways to measure the involvement of the user. We can state that there are two major ways to measure the involvement, Self-reporting and Physiological approaches. Self-reporting includes such methods as questionnaires, surveys, interviews. Psychological approaches includes such methods as observation, facial expression analysis, speech analysis, physiological signal processing, desktop actions.(Lalmas, M., O’Brien H.L.) It is proposed (Barki, H., Hartwick, J., 1989) to use an approach of creating a 7 point-item scales questioning personal relevance, e.g. measuring user involvement. The items include in questionnaires and then quantitatively analyzed. Users were concerned with the new system which is ought to be developed, and the feelings of the system recorded. Barki H. also stated that the user participation is the way to make user involved into the product, thus participation is antecedent of involvement. To put it simply, people who participated and were aware of the product were more likely to have a better attitude towards new system. People when interacting with new system feel some type of ownership of that system, may detect the advantages of the product and understanding how it could be helpful for them. What is also interesting that attitudes and feeling of the product is hard to change, after initial ones are implemented.( Wyer, R.S; 1975)[[58]](#footnote-58) Therefore involvement with the product should be mainly set up in the beginning of the requirements development.

Judith L. Zaichkowsky proposes to measure involvement by a semantic differential scale, which includes such word pairs as interested-uninterested, exciting- unexciting, which should indicate the involvement of the user. The semantic value of the responses are classified to the batches, whether the user is involved or not involved. Then the batches are refined and more consistent user involvement questions are derived. Generally, by many authors( e.g., Belk 1981; Bowen and Chaffee 1974; Lastovicka 1979; Lastovicka and Gardner 1978; Mitchell 1979; Robertson 976; Tyebjee 1979; Judith L. Zaichkowsky, 1985)[[59]](#footnote-59) the low involvement is derived from:

1.A relative lack of active information seeking about brands;

2. Little comparison among product attributes;

3. Perception of similarity among different brands;

4.No special preference for a particular brand.

5.The opposite of low involvement is high involvement, the 7 point likert scale were introduced to measure it. Which oppositely look like this:

1.I would be interested in reading information about how the product is made;

2. I would be interested in reading the Consumer Reports article about this product category.

3. I have compared product characteristics among brands of this product.

4. I think there are a great deal of differences among brands of this product.

5. 1 have a most preferred brand of this product.

User involvement suggests us to use interviews, surveys and questionaries to measure involvement. Involvement into the product could be experienced by a stakeholder, team member or user. Involvement is a crucial component of effective participation, and during requirements development building involvement is a base stage before trying to get the needed information. We have seen that participation is an antecedent of involvement, thus while conducting the meeting involvement could be produced by several techniques. Practitioners could introduce the product to the stakeholder, demonstrate its advantages and give it a try to build involvement. Judith L. Zaichkowsky’s measures of the involvement are easily introduced in the form of questionaries during requirements gathering.

# **3. Methodology.**

## **3.1. Objectives of the research.**

The objectives of the work are: 1) Identify the most important stages in requirements development in banking context; 2) build the framework which takes into consideration all of the important decisions in requirements development process; 3) Identify suitable techniques for requirements development in banking context. We should mention that conforming with the objectives is essential to our research, but we will not forget the wider aims of the research.

Our research will incorporate mostly qualitative methods, related to the mechanics of the research process. The interpretive nature of our research calls for such methods as deep interviews, workshops, and theory refinement, thus our study is inclined towards a qualitative direction.

 The Reasons to use the interpretive study approach are within the nature of the problem we are facing. The problem of business in the need to improve the efficiency of creating a system in this area is closely related to the creation process, which includes not only organizational issues and processes but also the human factor, team management. That is, in our work there is an analysis of decisions, risks, and management issues that are associated with specific people. The interpretive approach is more consistent with analyzing human actions in an organization and it is appropriate when uncovering new insights about the phenomenon under the study.

We will obtain information mainly through interviews with various subjects of the system. During exploration two primary methods of data collection were used, those being interviews and observation of previous project’s results. The interviews were concerned about important events and actions which take place in the banking environment. We also had a chance to observe the usage of the system in different time frames and versions to get an idea of the differences.

We address the following research questions:

1. How do practitioners perceive importance of different stages in requirements development in banking?
2. How do practitioners perceive the influence of external variables on requirements development?
3. How can we optimally align stages the requirements development process in framework in banking context to be more effective?
4. How can we adapt the requirements development process to describe the development of the merchant classification system and similar to it?
5. Which techniques and methods are most appropriate to use in requirements development in banking?

To address these questions, the current study sought to develop a multicriteria decision analysis framework that allows a manager to analyze the interrelationships among different components of the merchant classification system to get the best possible result. Practitioners were interviewed and case study on merchant classification system has been conducted.

In online banking, in which there is no yet structured decision-making process on merchant classification system building present, we can provide a framework that can be used by managers to develop insights into the relationships of their decision to the goal of creating a coherent system. The methodology stages are summarized below.

|  |  |  |  |
| --- | --- | --- | --- |
| № | Purpose | Techniques | Participants |
| 1 | To get the idea of сurrent requirements development and management process in the organization | Sem-structured in-depth Interviews | Product managers/Product owners in banksBusiness analysts in banks |
| 2 | To get an idea of the banking environment and how it corresponds to the requirements building process. To get the idea of user participation in requirements development process. | Sem-structured in-depth Interviews | Project managers in banksProduct owners in banks |
| 3 | Confirm the clarity and accuracy of the requirements development framework | Sem-structured in-depth Interviews | Business analystsProduct managersProduct owners |
| 4 | Get the data on requirements development on previous and current iteration of merchant classification system | Documentation analysis, observation, interview | Product owner responsible for the previous project |

Table 2. Methodology stages.

Source: [authors research]

**3.2. Case description.**

Our research is conducted considering management as a reference discipline. We consider elaborate on the organizational processes the way it is and the way it should be, finding the ways to increase the efficiency of the current requirements development settings. We provided a single case study with varying participants of the research.

The company under research is one of the biggest Russian banks, the production process combines strict adherence to uniform principles with great autonomy of individual teams. The structure of the organization consists of cross-functional teams formed according to the needs of the client. Unlike the traditional model, in our case, teams can make decisions autonomously, regardless of the decision of the higher management. The team shares responsibility for the value of the product, the responsibility is not delegated only to team leader. Teams are mostly constitute from 3 to 12 people with constant work towards product. Frequent demonstrations of the products to interested parties and receiving feedback from them replaces constant control based on bureaucratic processes. For software development organization uses agile principles. The main principle of software development for our case is the incremental and iterative development. After the each iteration mvp is ought to test and collection of feedback. Documentation of the requirements is not rigorous and inclined towards user stories. Maximum automation of development, testing and value implementation processes through practices DevOps/Continuous Delivery.

In this organization design is a crucial step in formulation product requirements. The main tasks of the elicitation of requirements are:

1) Research of the current product and competitors in the market;

2) Define the vision, value proposition, and visual elements of the product;

At the design and prototyping stage of the main tasks are:

1) Research of the current product and competitors in the market;

2) Preliminary deep research;

3) Formulation of product hypotheses;

4) Zero based design workshop

5) Creation of the prototype

6) Testing the prototype with users

Those actions included in elicitation, design and prototyping stages on average take about 3 to 5 weeks. The methods which mostly take place are market trend analysis, qualitative and quantitative research, deep interviews, focus groups, surveys, observations.

## **3.2. Study design and data collection.**

We designed the study based on Runeson and Höst (2009)[[60]](#footnote-60) case study guidelines and decided to follow a single case study design. The purpose of improving is evident in our case, since we describe the phenomenon already studied and try to improve the certain aspect of the theory in requirements management. Also, our research is descriptive, since we describe the requirements development in particular context, which has not been studied before.

The sample of the practitioners were set by the following criteria: 1) Works in the banking context for at least a year; 2) Has necessary experience in developing and managing requirements for software or product development for at least a year. Also, to ensure of the reliability of the sample we applied key informant technique (Marshall, 1996)[[61]](#footnote-61) to have people which are familiar with the subject of the requirements development and with organizational environment. We conducted 10 semi-structured deep interviews with 10 practitioners and with 2 users. The interviews were conducted between march and may of 2022. 9 out of 10 were audio recorded and lasted from 30 minutes to 1 hour.

## **3.3. Sampling strategy and Data analysis**

Data analysis will intercorporate thematic analysis approach (Cruzes and Dybå, 2011).[[62]](#footnote-62) The audio recordings were transcribed we then attach the code to the appearing topic under interest. For example, we will code the importance of user participation during requirements development. The similar approach is applied to other recurring topics of the interview. Then we revised the similar topics occurring in the interview, similar answers and importance to draw the common theme. This happened to help us to answer our research questions, with recurring topics. Then we compared answers, draw necessary relationships, and grouped related subjects.

To identify the influencing processes of the requirements development, we first conducted a series of interviews with experts to get the main variables. The interviews were held through video calls and were recorded. Experts answered open questions and based on their knowledge of organizational processes revealed their views on processes influencing the requirements building process.

The sampling strategy could not incorporate random sampling, since we do not need to generalize the phenomena, but to explore it in the current setting. We do not intend to gain generalizable results to apply it to all other contexts, but to get the idea from the practitioners who possess the specific information. Our sampling strategy includes the maximum variation and snowball sampling, therefore practitioners recommended other individuals for the interview. We got the representative sample of 10 practitioners with varying experience in terms of years, roles, and different organizational background. Each interview lasted varying from 30 minutes to 1h. The characteristics of the interest were: 1) Experience with requirements development and management; 2) Experience in requirements development and management in banking environment.

Semi structured interviews were decided to be the main data collection methods since:

1) Deep interview gives participant an opportunity to describe complex topics and gives time researcher to react and draw insights on the topic

2) Answers can be easily compared against other interview participants

3) It gives opportunity to unfold personal experience with the topic in details

The summary of the participant’s sample is presented below. To keep participants anonymous we gave them IDs.

|  |  |  |  |
| --- | --- | --- | --- |
| ID | Role | Years of experience in requirements development | Previous experience outside banking |
| P1 | Product owner | 3  | + |
| P2 | Product owner | 7 | + |
| P3 | Product owner | 5 | - |
| P4 | Product owner | 2 | + |
| P5 | Lead Business analyst | 3 | + |
| P6 | Business analyst | 9 | + |
| P7 | Business analyst | 2 | + |
| P8 | Business analyst | 7 | - |
| P9 | Business analyst | 6 | - |
| P10 | Business analyst | 8 | + |

Table 3. Summary of the participants sample

# **4. Empirical findings.**

To answer the research questions most fully, the necessary data were obtained and synthesized. Accordingly, the results of the analysis of interviews and secondary data are presented below. The example of the thematic analysis is presented below at table 4. We extracted the expressions and answers from practitioners and synthesized it into one semantic statement, which describes the views of different practitioners.

|  |  |  |  |
| --- | --- | --- | --- |
| P9 | First of all, interaction with **the team and stakeholders** takes place, it is best when a description of the product or project **is sent in writing, and then it is specified in more detail** **how it should look like.** | The requirement development initiated form the team itself of from stakeholders |  |
|  |  | The specifications sent in detailed and written form |  |
| P8 | **Depends on the task**. If we take an integration task, then it most often comes from above. We need to first request documentation with parameters, how integration will take place, its parameters. **First and foremost, this applies to any task, to understand why we are doing it.** At the beginning we ask why we are doing this**. Doesn't matter for internal or external user. After that, there is a meeting with colleagues and stakeholders, then the descriptions of the draft documentation begin.** | It depends on the task how we initiate requirements development. | It is important to consider stakeholders as a main channel of starting requirements development. The team can help with initiation and it is crucial to consider why the product is developed. |
|  |  | It is major to understand why we are doing the task. Then the meeting with colleagues and stakeholders happens. |  |
| P7 | **First comes the definition of the need, what needs to be done and why**. Further product research, what we already have on the market, what we can offer and how to adapt. **We collect requirements from other stakeholders through direct communication. We clarify and look at the risks.** | Firstly we identify the need, what should be done and why. |  |
|  |  | Requirements collection starts from stakeholders through direct communication.  |  |

Table 4. Thematic analysis example.

## **4.1. Definition of the image and boundaries of the project**

Requirements elicitation is one of the key processes in the formulation of requirements and considered as one of the first stages in the process, it is the process by which the requirements for the product and its boundaries are determined. In this phase, the focus is on identifying the user's needs for the product, its usability, user paths, and quality attributes. These requirements need to be effectively identified.

A systematic approach and good communication skills allow for a productive discussion and more effective identification of client requirements. There are various other ways to identify and document requirements, depending on the nature of the project. Flowcharts and decision trees are very helpful when considering the direction of a discussion. This is important because the user often needs additional stimulation to think effectively about their wants. The art of conducting a discussion comes with experience and with the qualities of the interviewer himself. It is important to find a common language and to simplify the language of the discussion as much as possible, without using complex technical terms. The result of this stage can be considered an agreed understanding of the needs of all user classes. A good approach to structuring requirements elicitation is to draw up a plan that should have clear requirements elicitation objectives, strategies and methods for obtaining requirements, defined requirements elicitation outcomes, a resource plan, and the risks that may arise from requirements elicitation. Documentation of requirements identification is also a very important stage, which includes verification of requirements by users, and brainstorming sessions to discuss the identified requirements, this will allow to identify disagreements at an early stage and identify gaps. During brainstorming sessions, analysts can come together to discuss requirements, identify patterns, and fix agreements.

When collecting information, one should take into account the balance of needs that are identified by different classes of users. It is important not to leave out important information about the different classes of users and not focus on just one class. When gathering information, it is also possible that the boundaries of the project will change. Many users need to change the boundaries of the project, especially in the early stages.

It is also important to realize that it is almost impossible to collect all the requirements at once. There will always be missed demands. There are several techniques for identifying missed requirements. For example, you can break general requirements into more specific ones, or top-level requirements into smaller requirements and then validate them with the user. Even if they fail validation, there is a good chance that the user will point out new missing requirements. But, even after analyzing the missed requirements, it is almost impossible to understand that the collection of requirements is completed. However, it can be determined that there are a few missed requirements. More often than not, the most obvious sign of this is that during requirement discovery, the user can no longer come up with something new.

*«The basic steps to identify requirements are very similar to other organizations. The first is getting information from stakeholders, as well as business goals, so you can understand what is needed and what are the approximate requirements. It is also possible to get information from colleagues who have competencies or have worked with similar systems. You turn to the documentation, evaluate what kind of system it is and what features it has, what architecture it has.»*

The thing here is that the process of elicitation does not seem to change form organization to organization, as well as formulation of business requirements.

*«There are necessary audit requirements, there are requirements for a single design code, security requirements are blocking requirements that should receive priority during development. The methods are based on interviews and observations. For internal systems, the choice of methods is no different, the same thing happens.»*

Another practitioner mentions that there is virtually no difference between the various organizations and systems, but some quality are mentioned which are happened to be the design, security and blocking requirements.

«Requirements were collected on the basis of peer review, specifically by the systems architect. When collecting requirements, the human factor and the level of expertise are very important. When collecting requirements, a team was assembled and we performed brainstorming. Some ideas were reflected in the product, some were cut off by themselves.»

Such factor as human one is mentioned here to play an important role in requirement elicitation. Also the brainstorming as one of the methods is identified.

 What is important in that stage is the determining of the image and boundaries. Determining the image and boundaries of the project is a necessary task that the person in charge faces. The product image or product vision describes the future of the product, while the project boundaries indicate what is included in the product and what is not. The specified boundaries of the project also include restrictions, both organizational and product. As we have seen in previous chapters, all requirements for a project must be consistent with the context and goals of the project. Projects that lack a common vision and direction are doomed to failure, as the team may not understand the project goals and prioritize them incorrectly and solve tasks that are opposite to the goals. In fact the most common problems of requirements are ambiguity and structurization, which could be solved with various techniques.( A. Syed & A. Khubaib, I. Umer, A. Sahar, 2019) [[63]](#footnote-63) This situation often results in many features being included in the product and then being revised and then returned. It is especially effective to define the requirements image and scope before the requirements specification and documentation, it is important to define the scope and image along with the definition of product features and releases, thus aligning the two domains.

It is worth noting that projects can be part of a larger strategic project or part of a smaller project. The product vision changes depending on the overall strategy of the project, if the strategy remains unchanged, then the product vision is unlikely to change during the project. The boundaries are more chaotic, they can change regardless of the overall strategy, and they can change according to various other variables, such as schedule, quality, budget, resources, etc. Project scope management occurs on planning defined by the organization or at the request of the team. For new projects, you need to create a separate document for the project boundaries. But little is known how team or responsible for the requirements development defines the project boundaries of the project, what are the deep roots of the logic underlying the definition stage.( R. C. Fuller, P. Kruchten, 2021) [[64]](#footnote-64)

Elicitation of requirements could incorporate many of the techniques including brainstorming, observation, joint application development, questionnaires, interviews etc.[[65]](#footnote-65)

All of the practitioners identified this stage as one of the most crucial, incorporating a lot of tasks to be deal with. The contribution of this stage is the successful acquire of the necessary information by such techniques as direct communication mostly with stakeholders. It is revealed that teams and stakeholders are the main source of information and finding the right stakeholders and making sure that they are involved in the product is a hard task, and one of the main blockers for the project proceeding.

The following information gathering techniques are most used. The first way is an interview, the second is review and analysis of documentation, the third is a comparison with similar systems, the fourth is the collection of information from colleagues who have expertise.

“The first thing that happens is an analysis of the current situation. You can use the documentation, talk with users, with stakeholders, see for yourself how it works. There are certain techniques that are used at this stage, but they are different for each business analyst. Next, you need to collect, structure and document the information received from interested parties. When collecting information, the first thing to do is to go to your team, and secondly, look for people with competencies outside the team. It's often the fastest way to gather information. The second step is to figure out how it should be. It is required to talk again with stakeholders, with users. The influence of stakeholders on the formulation of requirements is quite large. In other organizations, stakeholders only set a task and then look only at the result, and do not follow the project. Here, team members are more interested in the project and stakeholders follow the different stages of the project. As far as requirements gathering communication is concerned, the documentation is often not very good, in which case people should be contacted for information. It happens better when there is good documentation and there is no need to pull people.”

When starting from scratch, communication skills are important, and you redo the requirements several times. This is a very laborious process that takes a lot of time, we may see that practitioners seek for direct communication and value the rigorous vision of the project from the very beginning.

*“Everything starts with a project and with a problem, solutions are obtained. Some research is being done and then a solution is being sought. Project boundaries depend on the project itself, the culture in the company, and where the project comes from. The project can be vendor or organizational. Development units related to internal systems need funding, and for this it is necessary to justify the value of the project and opportunities. In the case of internal systems, these are most often not monetary indicators. The boundaries of the project within can constantly expand and the impacts spread to other departments, as in large organizations many departments can experience impacts from the project.”*

There we can see the different aspect which come into play when differentiating from the type of the project. There is also the evident hierarchical influence in terms of the positions is important since we need to know the nature of the project.

*“When developing the requirements, the development stages changed, it happened so that the designer first drew a prototype, and then a business analysis was carrying it out. There was also a reverse situation, when a business analysis was first carrying it out and a prototype was created on the basis of it. But in both cases, the requirements development document was drawn up after passing through these stages, these are some preliminary stages.”*

Here we can see the changing nature of the stages in the requirement development process, this is highly dependent on the project nature. But the risks of carrying out the project in different direction always can happen.

From this stage we can see the importance of team cohesion in challenging mutual problems and carry the ownership of the responsibility towards product under development. We detected the role of human factor, when the requirement development could be stopped by under involvement of stakeholders or other people responsible for the project. Therefore the perceived importance of that stage is on high level.

## **4.2. Identification of stakeholders**

The identification of stakeholders plays an important role in a critical approach to requirements development. It is very important to involve stakeholders at the earliest stages in order to get feedback on the product. To draw up stakeholder classes, it is necessary to understand the need. It is important to identify sources of information about stakeholders, divide stakeholders into subgroups according to characteristics, and agree on which of them will be responsible for a certain part of the project. Constant communication with stakeholders is a necessary element of requirements development, which will help to avoid disappointment in the project and may bring innovation.[[66]](#footnote-66) The element of managing stakeholder expectations during the development of requirements is very common since stakeholders do not always really know what they want, and often their expectations exceed technical and resource capabilities. Therefore, you should manage your expectations wisely and have a healthy discussion about requirements.

*“There are different ways of obtaining information from stakeholders. It depends on the product itself and the organizational environment. Of course, we should not forget that stakeholders are guided by the needs of their customers and users. Often separate departments are responsible for gathering information about customer needs upon request from the business analyst. If stakeholders do not understand user needs, the analyst must find them out himself.”*

 It is also possible to subdivide users according to distinctive characteristics, against which it is possible to define classes of users. It is worth noting that users can be not only people but parts of any mechanism or part of the application that uses the results of our product. They cannot be asked about needs, but they can be inferred from the design of the engine or the architecture of the application. There are various techniques for defining user classes, for example, one can come up with as many user groups as possible and then combine them into classes and subclasses (Gottesdiener, 2002). Very often, user classes are described as personas, with the most detailed description of their daily lives.

The direct communication is also an evident tool to gather information from stakeholders, practitioners perceive that stakeholders are the most evident source of information, but it depends on the nature of the project. It could be initiated from within the team, giving authority to make decision. And also the users play a huge role in formulating the requirements if the problem arises. Generally practitioners perceive this as a part of the initial stage, which could be fully integrated into the first stage, but if needed the iteration of formulation of stakeholders is present.

## **4.3. Selecting user participants**

Selecting users is one way to collect and critique product requirements. Engaging a product involved user is an efficient and structured bridge between an organization and user needs. Ideally, the user should be the real consumers of the product, and it is advised that not employees pretending to be the user. However, an employee can also be an involved user, the main thing is that he must be an active user of the product. This may even be a more effective option, as communication with such a user will be more consistent. A very important attribute of a product user is that it represents a whole class of users and can make decisions on their behalf. Relationships with a user should be structured. It is advisable to describe the responsibilities by category so that the product champion understands what kind of expertise is expected from him. It is important that user constantly involved in development process, that will improve the feedback.[[67]](#footnote-67)

Of course, there can be several user classes since the user is not only representing only one of the user classes. If there are multiple user classes, then there will be multiple people. Of course, different people present different product requirements, and it's important to manage their expectations the right way. It is worth remembering that often the participation of users in the project is the determining factor for success (The Standish Group, 1995). But selecting and managing user feedback may be a very rigorous and time-consuming task. As one practitioner mentioned.

*“Selecting user representatives in reality is long, expensive and inefficient. There used to be a usability research boom at the bank, but it's not popular anymore. All these studies are useful, but it takes a lot of time, during this time you can release 5-10 versions of the product and check them out. It is cheaper and faster to do 10 iterations and get some result, and in fact it turns out to be more risky, but more effective. The second problem with engaging users in research is that users themselves do not know what is best for them. It takes a lot of time to select a good sample of users who really know what they want. All research boils down to turning to an expert who has extensive experience in interacting with clients and conducting research, and validation occurs through him. In any case, according to the production process, it is necessary that the validation occurs through this person, so this reduces the time.”*

*“In our case, we decided to keep all the best, while minimizing the complexity of the client journey. We do not often conduct research; it is very time-consuming. We limited ourselves to our own understanding of the client and turned to experts for advice. “*

*“It is useful to create surveys, most often mass surveys are created. You can also order research about customers. In cases where users are often not asked about requirements, this leads to users not using the product.”*

Another perspective on user participation is collected. There is a classic notion that the product without user feedback might not suit the user needs. This does not contradict the previous thesis about the disadvantages of the user participation, but sheds a light

User engagement depends on the culture, whether it is customary to communicate with the user and build a product based on feedback. It also depends on the actually built and working processes in the company. For example, in one of the other banks in which I worked, user testing is a necessity, which also goes sometimes to extremes. To conduct research, you need to familiarize yourself with all the necessary procedures for collecting user feedback, the reality is that you can’t just come to the research department and ask for statistics or invite users to an interview in a simplified manner, you need to go through a lot of bureaucratic procedures. The selection of a user representative can be done through various tools. Often there are chats where employees or users can write about a bug or desired product functionality.

Here the practitioner emphasize the importance of bureaucratic procedures, and business processes which sometimes influence the participation of users. It is also not every time useful and can go to extremes when the other aims of the project are neglected.

Overall the participation of users seem to have a mixed value among practitioners, while the advantages are evident for some of the practitioners, other emphasize the shortcomings of such an approach.

## **4.4. Determination of the person responsible for making decisions regarding requirements**

When identifying user needs, user expectations must be properly managed. You should also identify the people responsible for making decisions on the development of requirements in the project. If organizational rules do not specify who makes decisions, then decisions are made regarding competencies and tasks. Often this approach leads to contention and inconsistency, a lack of focus, and a lack of strategic vision for the goals of the project. There is no single right decision as to who should make requirements engineering decisions. Often this is an employee with leadership qualities and high product expertise. There are different ways of making decisions, some collective and some individual. Some are regulated by the organization, and some are not. In the event of a dispute or conflict situation, it is necessary to use the established decision-making procedure and appeal to it. There are also other techniques for finding a compromise. It often happens that as a key factor in making a decision, the decision or conclusion of the user is chosen as an argument. It is important to understand what proportion of a particular class is of users and prioritize users.

*«When developing and validating requirements, we connect users, in order to check how the product prototype meets their requirements, this is convenient and not too complicated. For us, the user was in many ways the source of product decision making.»*

Here is an evident use centered approach to verify the requirements, so to say to test it. In the dispute the users are responsible for aligning different viewpoint.

«As for the inclusion of users, it all depends on the project that is being worked on. Some services do not require client immersion when it comes to internal systems. Work with the client in the case of commercial systems should be in any case, it can be in advance if it is a new product, with a large amount of research. If this is a service with refinement, then here you can focus on competitors, and improve your service by analogy. Users could give valuable insights on resolution of particular problems.»

Here practitioner said that the inclusion of the user to deal with product ambiguity is not necessary and appealing to competitors is the way to manage the things. Here the important variable comes, the usage of competitors experience when dealing with tasks. It is quite common techniques for the banking context as we will see in the following section.

## **4.5. Define Use Cases**

It is very important to understand how the client uses the product, this allows a practical approach to development, using only the necessary functionality. The use case describes a single user's way of interacting with the system. It describes how the user will use the system. The complexity of internal calculations and software algorithms is not considered, only the interaction of the user with the system is important. A user in a use case can be either a person or a system. User scripts have a number of advantages associated with improved visualization and description of user tasks in the system. One use case aims to describe a single action on a system to produce a specific result. Use cases can be basic and alternative, the main use case describes the most frequent and targeted use case, and the alternative appears under certain conditions. Most use cases are described by UML diagrams, this is designed to unify the understanding of the elements of a use case.

To define use cases, it is necessary to define the actors and the business processes in which they participate. Next, it is necessary to describe the business processes along with the actors and identify external events that affect the process and the system and actors' response to it. And finally, consider what are the main and alternative use cases. Use cases can be complete or incomplete. Incomplete use cases contain a general description of the goals and actions of the user in the system. Full options contain detailed options for using the system with testing, entry options, and internal components of the system. Full options are used more often in complex systems where the project team does not work closely to refine requirements.

Developers implement functional requirements, not business requirements or use cases. Use cases play the role of a language in which information about the user's intentions and actions is communicated. It is recommended (Arlow, 1998) to describe in detail the functional requirements to avoid ambiguity and misinterpretation of the requirements. There are different ways to describe functional requirements.

*«Writing use cases is important when creating requirements, it is one of the main ways to understand the product. Thanks to this, a common vision is created. This is followed by discussions and proposals on what it should be, how and what problems to solve, what functionality, for whom it will be, on what platform.»*

The practitioner says that this is primarily done to create and follow the common vision, to understand the product which is ought to be created.

*«In our case, the user case is perceived as a description of the system functions. This is one of the elements of knowledge transfer. This is a cheap way to replace the classic study, where you try on the role of a user. It's important to focus on the small details in use cases, because most of the time is spent on small things, such as the reconciliation process. The approval process can be very slow if you simply do not find the right person for approval, or this person does not respond.»*

The other practitioner emphasizes the importance of using use cases, but the value of such an approach comes from details. It is important to pay attention to small details, such as bureaucratic procedures and finding appropriate people.

When writing use cases, you need to prioritize the use cases into primary and alternative ones. You also need to understand resource constraints, delivery schedules needs priorities, and prioritize use cases. Prioritization allows you to prioritize work to provide maximum value with the least number of resources. Prioritization is especially important with strict time frames and strict rules for planning the use of resources. Prioritizing use cases is important in the early stages of prioritizing user functionality.

It is important to consult with users when setting priorities, as their requirements may change the priorities of use cases. Prioritization also becomes important in the later stages of a project when features need to be removed. The three most commonly used priority scales are high, medium, and low. The prioritization process should be streamlined and simple so that everyone can contribute.

*«Prioritization of use cases is important, there is a main path and an alternative one. Usually there are two metrics that determine the priority, these are criticality and frequency of use. Different use cases have different combinations of these two metrics.»*

Here practitioner points out that the main metrics to prioritize use cases are criticality for the system and frequency of use.

The process of creating use cases can be carried out in several ways (Ham, 1998; Larman, 1998).

1) Define the actors and then the business processes in which the actors participate.

2) First define the business processes, break them down into activities and then identify the actors.

3) Using functional requirements to define use cases.

It's important to understand that you can make mistakes when using use cases. Don't use too many use cases, don't overcomplicate your diagrams, and use case descriptions. Also, you should not do the work of the designer and choose which interface elements appear when the user interacts with the system. It is worth considering this as interactions and needs of the user with the system and avoid particularities. Use cases must be presented in a manner that is understandable to the user, otherwise, the validation step may become difficult.

## **4.6. Indication of quality attributes**

It is important for users not only what functions and capabilities the product provides, but also how effectively it does it. Speed, ease, number of errors, and handling unexpected situations are very important things for the user. The evaluation of these parameters is called quality attributes and is included in non-functional requirements, it is often argued that non-functional requirements can determine the success of a project (Robert Charette, 1990). Non-functional requirements deal with customer needs, identifying and managing them, so it's no wonder they carry so much weight in a project.

Quality attributes can describe things like the architecture and design of an application, which are related to the visual attribute and the responsiveness attribute. There are a lot of such characteristics, but it is recommended not to produce too much of them(Charette, 1990). Quality attributes have a different priority and specificity for each product, for systems with personal information about the client, security must be prioritized, for desktop systems, ease of use and speed are emphasized. Accordingly, each system has its own optimal mix of attributes, which has priority. It is important to define this mix for the system to work effectively.

To identify quality attributes, it is also important to work out the needs of the client. This is not an easy job, because often clients cannot answer how important this or that attribute is, for them all attributes are very important, and the better, the more satisfied the client is. Therefore, it is important to design a qualitative survey that will prioritize and give measurable results on quality attributes. Perhaps you should go the other way and ask questions about the most unacceptable errors in the product, then you can understand which attribute of quality is the most important. Trade-offs around requirements are inevitable, developers and users must decide which requirements to sacrifice. The definition of quality attributes is also important in the further formulation of functional and design requirements.

Some of the practitioners could not distinct the special to the banking environment quality attributes.

*“With regard to the organizational environment, there is not much difference between the banking and non-banking environment. The main difference is the seriousness of the requirements for the system, the bank has very complex systems and the requirements are much more serious, especially with regard to security.”*

Other revealed that important quality attributes can refer to the fault tolerance, task execution time, number of errors. Also if the system is user oriented, then such attributes as customer satisfaction, personal security, feeling of the completion of the task.

*“Quality attributes may vary depending on the system. Fault tolerance, task execution time, number of errors are very important attributes of quality. More subjective attributes are customer satisfaction metrics, but these are not commonly used in internal systems. Security is naturally also included in the list of important metrics, this also indirectly applies to errors. You can also note the measurability and impact, users should feel that they are not just performing tasks in a cycle, the process must be finite and the user must understand the process.”*

Also there is a clear mention of the business goal and its relation to the requirements development. The banking system requirements seem to be perceived rather strict by practitioners. A number of practitioners mentioned that the complexity of the system interaction may prolong the requirements development process.

*“Criteria for success that come from the business goal. The bank has strict requirements for the system, this determines the acceptance criteria. The measure of success in requirements development can be comprehensibility, where the developer and designer have fully understood the requirements. However, it does not happen that the requirements are not specified - this is a utopia.”*

*“Quality attributes for complex systems with many dependencies must take into account internal systems and many dependencies. Load requirements are very important in this case, going into industrial use is also a big success factor. Other factors are subjective and depend on the project.”*

## **4.7. Define and document functional requirements**

Functional requirements are the behaviors of a system that enable users to perform their tasks. Functional requirements reflect the details needed to implement a use case. Many functional requirements are obvious and do not need further clarification, while others need to be identified and documented. There are different ways to document requirements. For example, documenting only use cases involves describing the functional and non-functional requirements in the use case. It is possible to simply write out the use cases and document the functional requirements in the specification. Sometimes it is expected to add use cases and functional requirements together in a specification.

The advantages of using functional requirements and separating them from non-functional requirements can be called a focus on a separate area of work, when the developer knows exactly what kind of functionality is needed to be develop, it does not have been pre-separated the functional requirements from non-functional ones. There are also a number of advantages to using functional requirements in use cases. Developers can more easily convert use cases into algorithms when they are in context. Developers using object-oriented design methods can convert use cases into object models, such as class diagrams and sequence diagrams.

There is a clear preference towards visualizing functional requirements among practitioners. It is common to present functional requirements in the form of use cases, schemes, data flows. It is said as understandable way of transferring information to developers.

*“Functional requirements are described in the form of schemes, in the form of diagrams most often. You can also describe the functional requirements in the form of a use case, but they must comply with the standards. Architectural schemes, schemes of data flows are also used.”*

After the presentation of the functional requirements, practitioners tend to improve the requirements. The most common technique is direct communication with developers on questions which bear uncertainty.

*“Scenarios and user requirements go along with functional requirements. One way to get information about functional requirements is to communicate with the development team and testers. The Development Team is asked questions - this is all information gathering, developers and testers are people who collect information about functional requirements.”*

## **4.8. Requirements Modeling**

Requirements can be written in different ways, and have different effects. Some requirements are best displayed as a UML diagram, some should be displayed as an interface prototype, and some should be displayed as a text version of the user's steps. The main means of modeling requirements are various tools. Visual representation models include data flow diagrams, entity-relationship diagrams, state transition diagrams, use case diagrams, class diagrams, and interaction diagrams (K. Wiegers, 2004).

Such models are important for requirements development, design, and other product development tasks. Modeling is designed to logically display important aspects and interactions of the system. By following the modern requirement techniques it is possible to clarify the most part of the requirements, bearing as less pitfalls as possible.( D. Leffingwell, D. Widrig, 2003; K.Pohl, 2010) [[68]](#footnote-68)[[69]](#footnote-69)

The overall modeling of requirements is mostly done to present visualization of the product. Many practitioners perceive it as visualization in a sequence of tasks.

*“To put it simply about methods, firstly you need to make a visualization using a sequence diagram, then a meeting with the team, brainstorming and validation of your logic. And in the end, the shortcomings are revealed.”*

## **4.9. Review the requirements specification**

A requirements specification is usually written as a document that specifies the features, capabilities, and limitations of a product. The specification is an important document based on which the planning of functional requirements takes place. The requirements specification specifies the behavior of the product under different scenarios, design, testing. If the requirements cannot be described, this may mean that business analyst should contact the user and collect the requirements again. Requirements specifications are important to all project team members and users.[[70]](#footnote-70) In fact, the requirements specification acts as a final repository of requirements, with the required level of detail. Of course, given that the requirements specification will be evaluated by a large number of people, the language of presentation should be universal and not have a double interpretation. It is important to document the requirements specification before implementing a particular piece of functionality. For correct interpretation, it is necessary to use clear headings, visual artifacts and have an understanding of the logic of the narrative. Organizations often have their own requirements specification templates, with various methods applied in particular project. The myriad of methods is present in current research agenda of requirements specification.[[71]](#footnote-71)

When following a template, it is necessary to give a certain freedom in choosing a solution to the needs of the client. A detailed description of the requirements helps, but should be as detailed as possible to ensure understanding. Also, do not put too many restrictions on product development, they must be justified. It is also necessary to choose the most convenient way to display the requirements, if we are talking about the architecture of the system, then the UML diagram will be useful, if we are talking about user steps, then a numbered list will be sufficient. To unify the understanding of the system, especially if it is a complex system, it is necessary to use a glossary of terms. The dictionary of terms will allow you to speak the same language, integrity is increased if the team uses definitions from the dictionary

## **4.10. Prototyping**

Prototyping is the creation of an early version of a product in order to analyze and correct requirements. Prototyping allows to evaluate the requirements by the example of a real product, makes the requirements more realistic. Even with a gradual and consistent requirements development process, it is often not possible to identify all requirements. When prototyping, the number of indefinite requirements dries up. There are different types of prototypes, depending on the purpose. There are horizontal prototypes that only visualize functionality without a backend. There are vertical prototypes that affect the entire functionality of the product, but without the back-end part. There are one-time prototypes that are created to make a certain decision. There are evolutionary prototypes that have the functionality of the target product, which plays the role of the initial stage of product development. You can also use a paper prototype, which is very quick and easy to use, but useful for less important tasks.

The main outcome of prototyping is the collection of information to improve the product. The collection of information should take place with the user through interviews. A script must be created in which users must perform certain actions. You should involve different users to look at the product from different points of view. Many problems and opportunities can be identified using different classes of users. Observation of the user's work can also reveal many insights about the product, so you should carefully observe the behavior and ask appropriate questions.

Success factors for prototyping include clearly stating the purpose of each prototype, building multiple prototypes, building one-off prototypes quickly, prototyping only what you need, and using plausible prototypes.

As practitioners mentioned, prototyping is not essential in the requirements development process. But the department and team ethics could be determinant of the usage of the prototypes. Some of the teams value such kind of testing the requirements.

*“Prototypes in our case are not created, in the classical sense of the process. This stage is skipped because there is a system design for the entire organization.”*

*“We only connect the user at the initial stage if we need to test prototypes. For each department, the importance of prototyping for user testing varies. The visual characteristics of a prototype are especially important in testing. The perception of the product will be better, it will also allow you to understand how convenient the product is.”*

## **4.11. Architecture development**

The system architecture reflects the fundamental organization of the information system, the connections of the components with each other and the external environment, and the principles that determine the structure and development of the system. Other applications may be included in the system architecture, depending on the type of system. Architecture requirements allow developers to write code in an orderly manner and eliminate the need to think through the architecture. Also, the requirements for the architecture are written for openness and the possibility of further changes. When modifying a system, developers must have access to information about the system architecture and quickly and consistently proceed with the modification.

Majority of the practitioners said that architecture is important when considering the relation to other systems in the bank, this bring the clarity behind the interconnections.

*“System architecture should be developed in every project. Because connections with other systems must be taken into account, without architecture people will not understand how it works and what dependencies exist. Even in internal systems, this is important, because they have many interconnections.”*

*“Banking architectures are associated with very different domains, and it is very difficult to fully understand the whole picture. In a bank, the creation of new systems can involve so many levels, and requirements are often developed for only a small part of a large system. New requirements for the system are divided into components according to the need, if the requirements for the system are related to another system and they are similar, just a link occurs.”*

## **4.12. Development of test cases**

Testing is a necessary part of a project. Most often, testing is carried out after the creation of an increment or a prototype. The purpose of testing is to identify problems in a product. Requirements verification allows to understand whether the requirements are complete, correct, feasible, necessary, prioritized, clear and verifiable. Testing reduces future changes and speeds up product delivery.

Reviewing requirements is considered being a testing. This is a good way to identify unclear or ambiguous requirements. There are such types of requirements view as:

1) Request one colleague to review requirements.

2) Requesting several colleagues to review the requirements.

3) Product description and critical analysis.

The official testing procedure is regulated and, as a result, has a document that reflects the defects found.

There is also such a method as expertise (Fagan, 1976). Review is a rigorous process in which several experts take part and identify product problems. In this method, the roles of participants, the stages of examination, exit criteria and checklists of defects are defined.

Testing is also conducted based on functional and non-functional requirements. As soon as systems are tested, requirements are taken into account and many problems with requirements can be identified during testing.

Testing perceived as not a necessary part of the process, it happens on a demand and is not included in the business rules as a complete stage with its requirements. Also the most common risks at testing is possible inclusion to other systems and human factor or incompetence when assessing risks of the product.

*“Requirements testing does not occur as a mandatory process. This is a very time-consuming process, which involves very experienced testers. This is due to the production cycle. Ideally, a good document needs to be tested. We test on demand and this is an informal process. “*

*“When it comes to testing, there are different risks. Most often, these are risks associated with the possible inclusion of other systems during development and risks associated with the human factor, or incompetence. The architecture is redesigned many times during testing, due to improper management and prioritization.”*

## **4.13. Validation of usage, functional requirements, analysis models, and prototypes**

Requirements validation is the last stage and serves to check the description of the requirements specification, the completeness of the requirements, the accuracy of the reflection of the requirements, the consistency and quality of the requirements. Based on this, development and design follows, for a quality foundation of further steps, the approval of requirements is necessary. The assertion occurs not only at the end, but after each increment.

The change of requirements should happen periodically to maintain the odds of project success. Requirements change results such as addition, deleting, updating and re -designing.[[72]](#footnote-72)Therefore this stage is crucial in developing sound requirements.[[73]](#footnote-73)

Practitioners commonly agree that such thing as closing requirement development process is very vague, since new problems may occur. The iterations of refinement of requirements happen constantly dependent on the complexity of the product. Therefore the team must see the difference between delivery and goal and focus on the goal.

*“Requirements are constantly being clarified, there is never such a thing as to agree on the first time. But no more than five iterations, because this signals a problem. On average, 2 to 5 iterations of requirements refinement occur. During the meeting with stakeholders, requirements are often adjusted. Intermediate results must be refined and validated, otherwise problems cannot be avoided. Objections, new circumstances and desires for new functionality may come out. It is important to be aware of the difference between the delivery and the goal, the delivery is not the goal.”*

# **5. Analysis**

Our aim at this stage is to align and create the practical and understandable multi-criteria decision making framework. The framework is done by converting deep interview results and using appropriate literature. Our approach is based on assessment of perceived stages of requirement development in banking context, we based our framework on the at the micro level(McKinley, W. & Mone, M.A., 2009) of organizational context with interaction among individuals and teams[[74]](#footnote-74) The framework could be used to assess decisions during requirement development in the settings of banking organizational context and to help to adapt the decision-making practices, process models, and techniques for a specific project banking context. The overall process of requirements development is based on knowledge structure that reflect the practice of requirements development in banking and consists of the following distinct phases: 1) Requirements Elicitation or Initiation, 2)Requirements Analysis, documentation, validation. Those phases are similar to the logic of requirements development by McConnell S.(1996), but in our case we united the last three phases into one since the distinct component of our separation of phases was perception of the practitioners. They perceive mostly two major phases the Initiation of requirements development and continuous repeat of validation. Thus we will stick to that understanding of the phases, to keep the settings of the banking context precise. The phases itself broken down to smaller activities which are happening at a certain phase. Also to it is essential to identify all project’s attributes and assumptions to be able fit the framework according to attributes. The main assumptions of the project are:

1. Project requirements change during the project is expected to be from medium ( from 10% to 30% of requirement change) to high( from 50% of requirement change)
2. Product type is typically a system or software product
3. Team size working on a project is expected to range from 5 to 12 people
4. Organization is a bank with agile methodology of product development
5. The main product quality criteria should be correspondence of customer needs



Figure 3. Requirements development Framework in banking context.

## **5.1. Elicitation or Initiation.**

As practitioners revealed, the elicitation phase is the most critical phase in requirement development. During this phase the image of the product and boundaries of the project are identified. Overall, at this stage the solid ground for the project should be developed and then the details should be refined. The information is the main component at this stage, the most necessary information during direct contact with stakeholders should be gathered in the presence of the business analyst. As it was mentioned in a number of interviews that communication could be very difficult due to the personal communication skills and less involved stakeholders. The situation could be worsened by the long communication chain, due to the inability to identify stakeholders from the beginning.

The initiation phase includes a lot of activities associated with gathering the initial information. It includes the communication, how communication is structured, who are the agents of communication. This phase also covers the initial information analysis and documentation. The clear delimitation from the second phase, which was emphasized by practitioners is non-repeatable nature of the initiation phase, and the raw data gathering. Now we will break down activities from the initiation phase and proposed techniques which are suited for such activities. The activities identified at the phases are based on perceived nature of requirement development in bank, and techniques proposition is based on current scientific literature on the topic.

### **5.1.1. Finding facilitator for communication with stakeholders**

The situation calls for additional help from outside. It has been proved in the interview that help from the team members is one of the first things which comes to mind when solving problems. We assume that such approach prevails, since the individuals tend to communicate within the familiar settings with individuals, who bear less uncertainty in behavior. Therefore, the most prominent coordinated action is done by team communication. ( L. Garicano, Y. Wu , 2012)[[75]](#footnote-75)

Having said that, we propose to take a coordinated team action approach to deal with such an issue of communicating with stakeholders. It is advisable to take one team member, which shows the involvement to the project and propose him to facilitate the meeting with stakeholder. Ideally facilitator should be from the development team, the person who understands the possible issues with product from the development point of view. Such approach would make the chain of validating the requirements with developers shorter, thus decreasing the process of requirements development in the very first stages. The stakeholder could be asked more development specific questions, which will bring more clarity to the project from stakeholders view; such type of communication may change the product image and project boundaries from the beginning, by discarding not realistic stakeholder’s needs. Moreover, such team action promotes good atmosphere in the team, making more team members involved in the project at the beginning. Overall, when more than one team member seeking communication it is thought that it would be easier to get the stakeholder’s time to gather requirements.

### **5.1.2. Communication with stakeholders**

Another technique that could be helpful to gather information from stakeholder is usage of mind maps. This is a structured way of identify the realms of product, possible issues and needs of the stakeholder. Mind-mapping is a type of modeling, which is done to ensure the effective facilitation of communication, ability to uncover missing information and domains of information, organize information gathered from other elicitation techniques, and uncover inconsistencies and gaps in information.( A. M. Hickey, A. M. Davis, 2003) [[76]](#footnote-76) In the interviews the visualization was considered as an important instrument of transferring clear information. Since it is rare, when stakeholders document and transfer their needs in the structured document it is advisable to structure thoughts of the stakeholder from the beginning. It will help the team to gather the necessary dependencies of various other banking systems and ask appropriate questions. Since mind mapping is the task which should be performed by one of the participants of the meeting with stakeholders, the person responsible for gathering the requirements can focus on requirements itself, while other could perform mind mapping. Such distinction by tasks will ensure the productivity of the meeting.

Another technique to make the elicitation process productive is to categorize the requirements to the unified checklist. It will ensure that all of the necessary requirements are considered. It might be helpful to use Volere template[[77]](#footnote-77)to guide the process of requirements elicitation, since it provides a rigorous list of requirements for the system. But it might be to work-intensive, therefore we expect practitioners to use the essential requirements categories to include in the specification at the first stages. And it would be even better to adapt the Volere template to the bank specific requirements to check the most important ones.

The matrix could be developed to prioritize the stakeholders. In fact, one of the practitioners mentioned that he uses this technique and it works for him perfectly in banking environment. The prioritization matrix should be constructed given two main components: 1) Component of the system; 2) Stakeholder responsible for considering this component. Practitioner said that always multiple stakeholders from different departments consider the new system under the development, they challenge the components and consider its influence to the system. When developing requirements one should understand which requirements bear the most uncertainty, which are the most essential to the product and accordingly set the priorities in the matrix considering stakeholders. This way we can ensure that the communication will be more coherent and the odds of saving time in communication increase.

Of course the interviewing process is essential in the first phases of requirements development. It is essential to human beings and a way to collect a large amount of information.( Sharma, S. K. Pandey, 2013)[[78]](#footnote-78)But interviewing is the skill which requires an advancement and practice, the right questions should be asked concerning the development, design and testing. And as it was said by the practitioners, it comes only with the experience of requirements development and experience in the domain, in which the product is developed. Thus facilitation should be done by experienced individuals with appropriate soft skills and ability to lead the discussion.

### **5.1.3. Team meeting to challenge the requirements.**

Team collaboration is perceived as an important aspect in requirements development by our practitioners. The collaboration of various experts in their own area of knowledge helps to discover basic patterns, shortcomings and discover the concepts of knowledge. The collaboration could include such basic techniques as brainstorming, JAD/RAD sessions( Carmel, Erran & George, Joey & Nunamaker , 1995)[[79]](#footnote-79). The most commonly used in the banking environment is brainstorming. Pratitioners said that it is faster to do brainstorming than structured brainstorming with appreciation of roles as it happens in JAD/RAD sessions approach.

Giving appreciation to the user stories as one of the main tools of getting requirements comprehensive, we should apply user stories at the elicitation phase, after the gathering of requirements is done. At this stage the work with sprint backlog is necessary, in the backlog the responsibilities and schedule for activities of user stories need to be identified. The mind maps should be broken down to user stories. The team should gather together to challenge the user stories, see if they are realistic and prioritize them, the priority poker can be an appropriate technique to implement at this stage. The facilitator of the priority poker gather participants, in our case it is team members, stakeholders and if necessary-users. The cards of priorities from low to high are distributed among participants and they place the priority card on the story, which is by their view is the most important. The result would be agreed-on user stories, that should be sent to stakeholders.

### **5.1.4. Send user stories to stakeholders to receive feedback.**

This activity of sending the user stories or other visually constructed increment to the stakeholders means that we gathered and analyzed the initial information and should validate whether we get it right to move to the other stage. If stakeholders approve the logic of the increment then the team could proceed with the further requirements development. If stakeholders are not satisfied with the results of the elicitation, then the gaps should be reworked in the appropriate manner.

## **5.2. Requirements analysis, documentation and validation.**

Most of the practitioners mentioned that after the requirements gathered it is generally the case that the iteration of the requirements refinement and analysis repeats. But with the level and complexity of banking products, it is essential to have shorter iterations to make the process more cost effective. The analysis of requirements is a transformation of formal and often oral expression of needs into unified and understandable form to implement design or programming stage. Ullman( 2002)[[80]](#footnote-80) says that refinement of requirements is the process making requirements less abstract, and making quantitative inferences if possible. Although the needs are often translated via oral communication in bank, the case with transferring a document with specification of requirements is still present in practice but is more rare than oral communication. After the general feedback on initiation phase gathered the continuous refinement of requirements should start.

During the validation of the requirements a lot of other suitable techniques could be used to make the process more efficient. Practitioners commonly stated that the requirements process is different for various business analysts, every one of them has various techniques. But the unification of techniques and proving of the most valuable in the banking context may help junior business analysts to acquire knowledge.

For example, the misunderstanding of the requirements is stated as one of the common issues among practitioners. It has been revealed that during the stakeholder’s interview it is major to document requirements and ask as many questions as it possible, to get the requirements right and avoid another iteration of gathering of the information. We could not discard the human factor, which is stated by practitioners to be a common issue during requirement specification. The personal characteristics of the business analyst and stakeholder may bring more ambiguity into requirements elicitation stage, here the main thing is an ability to make people feel comfortable and create a friendly atmosphere. It is also concerns the issue of poor involvement of the stakeholder, there is no magic way to overcome this, it is also the personal characteristics of the business analyst. During the communication with stakeholders, practitioners suggested to document every meeting, with appropriate way of modeling the requirements. When validating the requirements it is important to get back to the documentation of the previous meeting and highlight the necessary questions.

The other problem, which could be solved by constant communication is the failure to meet the stakeholder’s expectations. Many of the analysts forget about stakeholders, and prefer to work in a team to get the idea of the end product. This approach may save the time of the team, but it is obviously bear risks. Therefore the constant communication, ideally it should happen after each considerable requirement specification iteration. The constant communication could be established at certain dates and time, at which the stakeholder could be free. Also, the prioritization of requirements is needed to be addressed, since the most sought of functions should be developed in the first place, the stakeholder needs to give the priorities in the product.

It should be mentioned, that the above techniques and methods could be used in every stage of the project life cycle after the initiation. The mix of methods are considered to be a choice of the practitioner.

### **5.2.1.Rewrite and close gaps based on feedback.**

After the general feedback is received, analyst can analyze it with certain techniques. To apply techniques properly, one should consider to keep only the necessary requirements, therefore merging similar actions as one; make the decomposition of the various parts of the requirements into manageable ones; find structures that are stable over other systems in bank and use the unified language.( Kotonya G., Sommerville I., 1998)[[81]](#footnote-81) These principles help to analyze complex systems properly.

The feedback communication is also a process which should be established properly. Constant communication and schedule of the meetings with stakeholders is a way to provide a coherent feedback and reduce time of closing the gaps. Therefore it is appropriate to establish the constant schedule of sessions with stakeholders.

Closure of gaps require team work, since there are many ways to close the gaps and rethink the concept of the product. It is not rare when during brainstorming new ideas come up. Therefore teamwork during closure of gaps is a convenient method to solve the problems.

### **5.2.2. Model non-functional requirements and system constraints.**

It is obvious need to create non-functional or business requirements before functional ones. Non-functional requirements describe general rules of the product functions. So it is necessary to create a full picture of the functional requirements. The functional requirements can come in variety of information.

To analyze the information it is appropriate to use e checklist matrix based on house of quality method on figure 5 (Brace W. & Cheutet V., 2011)[[82]](#footnote-82). The structured statement concerning feedback is broken down to smaller, more manageable components, which are ought to transform to requirements. This method is appropriate when analyzing stakeholders feedback and when creating user stories. The input in matrix areas will help to organize the analysis of the feedback. The user stories may be a handy tool to model non-functional requirements. User stories provide us with both the context and user-related tasks, the modeling is quite simple and ability to understand the information in user stories is universal and does not require special technical knowledge.

Then, the priorities should be stated and new dependencies identified, since it is crucial for systems in banks to identify all of the needed linkages with other systems. At this stage it is preferable to use the tools and techniques which are familiar to practitioners, not to bear more complexity in the process. Therefore UML diagrams, which are usable when creating user stories may be a way to document nonfunctional requirements. This will assist team members to prioritize the activities or functions to the system.



Figure 4. Checklist matrix based on house of quality method

The difficulty comes from the ambiguity of the some of the business rules, but business rules ensure the product will be in line with performance, business strategy and conformance with safety regulations. This aspect, which bears a lot of bureaucracy is considered necessary by the majority of experts, even if it slows down the process of development. Therefore, we propose to have a unified vision of the business rules and laws which influence the project. Therefore, we propose to incorporate the common template which considers the common issues and rules, associated with product in banking sphere. The Volere template is also useful in this sense and could be reused to enrich it with information concerning business rules. As we get from the interviews, the main business rules are concerned with security issues, stress testing, law obeying etc. Therefore, the common template should be obtained and reused during the requirements validation. By the unified usage of the template the knowledge of the business rules would be consistent, and the problem with ambiguous documentation concerning business rules would be solved.

The validation of requirements should be done to ensure that the requirements are in complete and correct form, with consistency among other documentation in the organization. The absolute validation technique(Brace W. & Cheutet V., 2011) is useful in the given context. This validation technique is easy to understand and could be used as a leverage for common brainstorming of the requirements. It is based on the assumption that there are three dimensions of requirements engineering, which are presented at the figure 6 below.

|  |  |  |
| --- | --- | --- |
| **Dimension name** | **Goals** | **Suggested scale** |
| Specification | Developing a complete system specification based on vague expression of needs  | Vague/Fair/Complete |
| Representation | Providing the visually understandable representation of requirements | Informal/Semi-Informal/Formal |
| Agreement | Advancing the common thought on requirements validation | Personal view/Common view |

Table 5. The three dimension of requirements engineering

The Checklist Oriented Requirements Analysis(CORA) framework(B. William, C. Vincent, 2011)[[83]](#footnote-83) might be a useful checklist to organize the analysis of the requirements development process. We propose a checklist structure model specifically to align the different components of the requirements development. This way we will ensure that the requirements are broken down to specific structures. The checklist requirement structure model is presented below, at the figure 7.



Figure 5. Checklist requirements structure model

The one important visualization element in the proposed model is the ability to link functional requirements to sub-systems, thus indicating relationship to other systems. Therefore complex product can be decomposed to various requirements, and interactions can be visualized to further brainstorming.

### **5.2.3. Model functional requirements and test cases.**

Functional requirements can be incorporated by the CORA framework discussed above. Functional requirements are the main pathways to write programming code and to design the product, therefore functional requirements should be constructed in more technical way. Appropriate technical language provides developers with an understanding of the product functionality. Practitioners revealed that developers value the concise and precise directions of the functional requirements development over more freely formulated requirements offering more space for creativity. Therefore when developing functional requirements it is best to use the template, which is familiar to developers. And use prescriptive requirements with concrete directions of development.

The development of test cases must be conducted during the functional requirements development, since a lot of practitioners revealed that testing might take a lot of time and it significantly increases the time of development. It is mostly happens that more and more test cases are included during the testing phase. Therefore, to reduce the overall process it is proposed to include test case development during the functional requirements development. The nature of functional requirements allows to combine those tasks, since they are very related.

Through UML modeling it is convenient to identify necessary relationships to other systems. As it was reviewed previously CORA framework can be a good template for identifying and visualizing relationships to other systems. Since this factor stated as one of the crucial we should consider it as a distinct component. Links to other systems could be developed by other visualization techniques, for example mind mapping works well here. But the consistency of UML tools is undeniable.

Major quality attributes of the banking systems are said to be ability to store and process large quantities of data, security and privacy settings, ability to be connected and be included in other banking systems, accessibility of the system by people with disadvantages. Therefore, those quality attributes need to be considered in the first place when developing system for banking environment. Other quality attributes are dependent on the nature of the system. The template of Volere and CORA framework might be enriched with those attributes in advance.

### **5.2.4. Model, manage, document and specify requirements**

After the functional and non-functional requirements are done, the designing and programming start in banking software context. Therefore, the requirements are considered sufficient to start other stage. While programming and designing additional questions may arise and further requirements refinement is needed. Therefore, the team meeting and communication with stakeholders would probably be happening. We suggest to apply the same techniques involving facilitation and analysis of the feedback from the stakeholders. Here the management of requirements is crucial, the communication should lead to concrete results, which ideally should be documented, time-management of requirements development should be considering the time of team and stakeholders for collective events.

Documentation of the changes must be in unified format, ensuring that other departments will have an understanding of the requirements in case of the collaboration or joint work on the project. Practitioners said that the documentation is done unorderly in the same system, therefore it is better to have the unified way to document requirements at least in your department or team and prompt other to follow the same documentation procedures.

# **6. Сase of merchant classification system.**

In this part we will provide the results of the application of the framework on a merchant classification system requirements development. This real banking software project was carried out by our framework. We compare the current iteration merchant classification system requirements development using our framework with previous iteration, when the framework has not been used. By this we will ensure the validity of the comparison, since the system and environment stays the same. The delimitation of our approach is that it is a single-project study, thus it examines the object in a single team and in a single project.( B. Kitchenham, L. Pickard, S. L. Pfleeger, 1995)[[84]](#footnote-84)

We should define the effects we expect our framework to have on the system, to make clear what measurements be the basis of comparison. To make that, we will formulate hypotheses, the hypotheses for a case study can be formulated the following way:

1. Using the framework to develop requirements for merchant classification system rather than not using framework has a positive impact on duration of requirements development process
2. Using the framework business analyst can reduce the number of iterations of requirements validation

The first hypothesis can be considered true if the following item is met:

Number of days from initiation of requirement development to delegation to the developers and designers is less in the approach using framework than not using framework

The second hypothesis can be considered true if the following item is met:

Number of iterations on requirements validation using the framework is reduced compared to not using the framework

The first hypothesis was tested by comparing results on the requirements development of the merchant classification system before and after application of the framework. It should be stated that the requirements development process before application of the framework was not observed directly, the results of the requirement development process based on the raw data on the days it took to develop requirements, no external variables affecting the requirements development process before application of framework identified and their effect is not measured. The case of merchant classification system development was carried out in one of the major Russian bank, the exact name of the bank is not stated due to the concerns of the confidentiality.

The second hypothesis was tested in the same organization and within the same system as in it was in hypothesis one. The test of the second hypothesis was based on the data on the number of iterations it took to validate requirements through communication with major stakeholders.

## **6.1. Description of the case settings.**

The system which is under the study is called merchant classification system. To put it simply the system is responsible for enrichment of the user’s transactions. Transactions are enriched with such components as logo of the merchant, the name of the merchant’s brand and category of the spending. All of the components the user can observe in internet bank or in mobile application of the bank. The system processes the primary data that was received from the merchant and converts by the programming language. The system has an interface through which the parameters of the enrichment are controlled, therefore the system is used by internal employees. The complexity of the project is medium. The requirements volatility is high. The team size responsible for the project was fluctuating from 7 to 10 people. The security quality and responsibility for the quality standard are high.

The development of requirements for such system before the framework was applied lasted for 6 months, or 120 working days. As it was recorded the in the project documentation, the initial requirements were concerned with more broader functionality, but the MVP product was eventually delivered with cut off of some of the features. For the requirements development only one person was responsible, and the team participance were limited by their expertise and role responsibilities. The project was delivered in agile environment and major requirements validation were brainstormed in team. It was documented that the project had 6 iterations of requirements validation before MVP was delivered.

After the application of the framework, the requirements development process changed its characteristics. In the first phase of elicitation of the requirements, two people participated in gathering of the requirements from the stakeholder. One being product owner asked important questions regarding the project setting, its interaction with other systems, the image of the final product. The other, being business analyst, also asked stakeholder about the project image, documented the domains of the MVP refinement of the merchant classification system were identified in the first stage. Business analyst also asked whether the domains were identified correctly and the additional information should be included. After that the initial requirements were gathered and structured. Team meeting took place to identify additional domains and possibilities of the development. Then the information was broken down to user stories and main components, and initial requirements in the form of user stories were developed. Then user stories were send to the stakeholder to validate the logic, and after successful validation user stories were prioritized using priority poker technique in a team. Product owner challenged and validated prioritization, and the second phase of requirements development analysis, validation and documentation started. Requirements checklist analysis and CORA framework were applied and 2 more iterations of validation were conducted. After the 4th validation from stakeholder the designer and development team took requirements to start their work. Therefore using the framework 4 iterations of validation with stakeholder were done. The requirements development process took 4 month or 80 working days. The summary of the two cases is presented below at table 6.

|  |  |  |
| --- | --- | --- |
| Component of comparison | Merchant classification system requirements before application of framework | Merchant classification system requirements after application of framework |
| Number of iterations | 6 | 4 |
| Number of days of development | 120 | 80 |
| Number of team meetings | 5 | 6 |

Table 6. Comparison of two cases of merchant classification system’s requirement development.

# **7. Conclusions**

Our work is dedicated to exploring and giving guidelines to business analysts in banking environment in the task of requirements development. We have addressed the requirements development in banking context with case studies, incorporating the practitioners perceived importance of the various stages in requirements development, and presenting the application of the framework on a case study of the development of merchant classification system. Our work reveals that the practitioners mostly perceive the 2 stages of the requirements development, being initiation and constant repetition of specification, validation and analysis of requirements. Also, deep interviews revealed that initiation stage is perceived as the most important in requirements development. We have gained an understanding of the particularities of the banking organizational context, with importance of communicating with stakeholders, the prevalence of direct oral communication in the bank, distinct quality attributes, constant issues.

The framework incorporated only the important stages and techniques based on the issues faced during requirements development. Techniques mostly dealt with issues of communication within and outside the team. The new techniques, such as mind-mapping, priority poker, facilitation, checklist matrix, CORA framework showed to be an effective within banking context based on the case study results. The framework can aid practitioners to make iterations shorter, communication more effective, which leads to better product overall. We hope that the work will contribute the banking requirements development research area.

# **8. Further research.**

The framework demonstrated quality results in making requirements development process more coherent and effective. But more case studies need to be initiated to challenge the framework and enrich it with more data. The future work should consider using the framework in other banks to make results more reliable. The customization and enrichment of other suitable techniques is expected.

# **9. Managerial implementation.**

People responsible for requirements development and management may use and adapt proposed framework. The framework should be adapted considering the organizational context and system peculiarities. It is said to shorten time to market of the systems and iterations of the requirements validations, but more research is needed to test and refine the framework. We hope that the framework will incorporate more case studies to enrich the area of requirements development in banking context.

# **REFERENCES**

1. Afiq Fitri ,Sanctions cut Russia off from global payments infrastructure, TechMonitor,[online] Available at: https://techmonitor.ai/policy/digital-economy/sanctions-cut-russia-off-from-global-payments-infrastructure( Accessed: 4 march 2022)
2. Colic M., Improving Customer Experience With Transaction Enrichment, [online] Available at: <https://databricks.com/blog/2021/05/10/improving-customer-experience-with-transaction-enrichment.html> (Accessed 16 April 2022)
3. A. Giovanis, P. Athanasopoulou, C. Assimakopoulos, C. Sarmaniotis, Adoption of mobile banking services, Int. J. Bank Mark., 37 (5) (2019), pp. 1165-1189
4. A. M. Hickey and A. M. Davis. 2003. Elicitation technique selection: How do experts do it?. Proc. IEEE Int. Conf. Requir. Eng. 2003: 169-178.
5. A. Tarhini, M. El-Masri, M. Ali, A. Serrano, Extending the UTAUT model to understand the customers', acceptance and use of internet banking in Lebanon: a structural equation modeling approach, Inf. Technol. People, 29 (4) (2016), pp. 830-849
6. A.B. Barragáns Martínez, J.J. Pazos Arias, A. Fernández Vilas, J. García Duque, M. López Nores, R.P. Díaz Redondo, Y. Blanco Fernández On the interplay between inconsistency and incompleteness in multi perspective requirements specifications Information and Software Technology, 50 (4) (2008), pp. 296-321
7. Abbas, Syed & Alam, Khubaib & Iqbal, Umer & Ajmal, Sahar. (2019). Quality Factors Enhancement of Requirement Engineering: A Systematic Literature Review. 13-135. 10.1109/FIT47737.2019.00013.
8. Abu-Shanab, E., & Pearson, J. (2007). Internet Banking in Jordan: The Unified Theory of Acceptance and Use of Technology (UTAUT) Perspective. Journal of Systems and Information Technology, 78-97.
9. Adarsh Kumar Kakar, How does the value provided by a software product and users’ psychological needs interact to impact user loyalty, Information and Software Technology, Volume 97, 2018
10. Ahmad, M., Abawajy, J., & Kim, T.-h. (2011). Service quality assessment in provision of library services. Science and Technology: Paper presented at the International Conference on U-and E-Service.
11. Ali Altalbe, “Software Requirements Management”, King Abdulaziz University, Jeddah, Saudi Arabia, 2015
12. Anol Bhattacherjee, An empirical analysis of the antecedents of electronic commerce service continuance, Decision Support Systems, Volume 32, Issue 2, 2001
13. Aurum, A., Wohlin, C.: Requirements Engineering: Setting the Context In Engineering and managing software requirements, A. Aurum and C. Wohlin, Editors. Springer-Verlag: Berlin, Germany.
14. B. Kitchenham, L. Pickard and S. L. Pfleeger, "Case studies for method and tool evaluation," in IEEE Software, vol. 12, no. 4, pp. 52-62, July 1995
15. Barki, H., & Hartwick, J. (1989). Rethinking the Concept of User Involvement. MIS Quarterly, 53-63.
16. Bloch, Peter H. and Marsha L. Richins (1983), "A Theoretical Model for the Study of Product Importance Perceptions," Journal of Marketing. 47 (Summer), 69-81.
17. Brace, William & Cheutet, Vincent. (2011). A Framework to Support Requirements Analysis in Engineering Design. Journal of Engineering Design - J ENGINEERING DESIGN. 23. 1-29.
18. Carmel, Erran & George, Joey & Nunamaker, J.F.. (1995). Examining the process of electronic-JAD. Journal of End User Computing. 7. 13-22.
19. Chi-Chuan Lee, Xinrui Li, Chin-Hsien Yu, Jinsong Zhao, Does fintech innovation improve bank efficiency? Evidence from China’s banking industry, International Review of Economics & Finance, Volume 74, 2021, Pages 468-483
20. Cho, Juyun. Issues and Challenges of agile software development with SCRUM. Issues in Information System.VOL IX, No. 2. 2008.
21. Cruzes, D.S., Dybå, T., 2011. Recommended steps for thematic synthesis in software engineering. In: International Symposium on Empirical Software Engineering and Measurement. IEEE, pp. 275–284.
22. D. Leffingwell and D. Widrig, Managing software requirements: a use case approach. Pearson Education, 2003.
23. D. Pandey, U. Suman, A. K. Ramani, “Impact of Requirement Engineering Practices in Software Development Processes for Designing Quality Software Products”, National Conference on NCAFIS, DAVV, Indore, 2008
24. D.W. Arner, J.N. Barberis, R.P. Buckley, The evolution of Fintech: A new post-crisis paradigm? University of Hong Kong Faculty of Law Research Paper No. 2015/047, UNSW Law Research Paper No. 2016-62
25. Demirel ST, Das R. Software requirement analysis: research challenges and technical approaches. Proceedings of the 2018 6th International Symposiumon Digital Forensic and Security (ISDFS); March 2018:1–6; IEEE.
26. Ebert C. 50 Years of Software Engineering: Progress and Perils. IEEE Software. 2018; 35(5): p. 94-101.
27. Ekman, P.: Basic Emotions. In Dalgleish, T., Power, M. (eds.) Handbook of Cognition and Emotion. Wiley, Chichester (1999)
28. F. Paetsch, A Eberlein, F Maurer - “Requirements Engineering and Agile Software Development“, 2003.
29. Francisco Liébana-Cabanillas, Juan Sánchez-Fernández, Francisco Muñoz-Leiva, The moderating effect of experience in the adoption of mobile payment tools in Virtual Social Networks: The m-Payment Acceptance Model in Virtual Social Networks (MPAM-VSN), International Journal of Information Management, Volume 34, Issue 2, 2014
30. Frandsen, Sanne. (2017). Organizational Image. 10.1002/9781118955567.wbieoc103.
31. Ginzberg, M. J. (1981). Early diagnosis of MIS implementation Failure: Promising results and unanswered questions. Management Science, 459-478.
32. H.L. O’Brien, Theoretical perspectives on user engagement, Why Engagement Matters: Cross-Disciplinary ,Perspectives and Innovations on User Engagement with Digital Media, Springer (2016), pp. 1-26
33. Haines, H.M., Wilson, J.R., 1998. Development of a Framework for Participatory ergonomics. Health and safety Executive Report, 174/1998, London, HMSO for HSE Books.
34. Heather L. O’Brien, Paul Cairns, Mark Hall, A practical approach to measuring user engagement with the refined user engagement scale (UES) and new UES short form, International Journal of Human-Computer Studies, Volume 112, 2018, Pages 28-39
35. Heinbokel, T., Sonnentag, S., Frese, M., Stolte, W., & Brodbeck, F. C. (1996). Don't underestimate the problems of user-centeredness in software development projects: There are many! Behavior & Information Technology, 226-236
36. Huffman, C. and Kahn, B. (1998). Variety for Sale: Mass Customization or Mass Confusion? Journal of Retailing, 74(4): 491–513.
37. Hussain Ahmad, Azham Hussain, Fauziah Baharom, “Current Challenges of Requirement Change Management”, School of Computing Universiti Utara Malaysia, Kedah, Malaysia
38. IEEE Guide for Developing System Requirements Specifications
39. Inflectra, “Principles of Requirements Engineering or Requirements Management 101”, March 1, 2018.
40. Jianxin (Roger) Jiao and Chun-Hsien Chen, “Customer Requirement Management in Product Development: A Review of Research Issues”, Vol 14, Issue 3, 2006.
41. K. Pohl, Requirements engineering: fundamentals, principles, and techniques. Springer Publishing Company, Incorporated, 2010.
42. Karin Garmer, Sven Dahlman, Lena Sperling, Ergonomic development work: Co-education as a support for user participation at a car assembly plant. A case study, Applied Ergonomics, Volume 26, Issue 6, 1995, Pages 417-423
43. Karina Curcio, Tiago Navarro, Andreia Malucelli, Sheila Reinehr, Requirements engineering: A systematic mapping study in agile software development, Journal of Systems and Software, Volume 139, 2018, Pages 32-50
44. Kotonya, G. and Sommerville, I., 1998. Requirements Engineering: Process and Techniques. John Wiley & Sons.
45. Kujala, Sari & Kauppinen, Marjo & Lehtola, Laura & Kojo, Tero. (2005). The role of user involvement in requirements quality and project success. Proceedings of the International Requirements Engineering Conference. 75- 84. 10.1109/RE.2005.72.
46. L. Garicano, Y. Wu, Knowledge, communication, and organizational capabilities, Org. Sci., 23 (5) (2012), pp. 1382-1397
47. Lalmas, Mounia & O'Brien, Heather & Yom-Tov, Elad. (2014). Measuring User Engagement.
48. Lu Zhen, Hai-Tao Song, Jun-Tao He, Recommender systems for personal knowledge management in collaborative environments, Expert Systems with Applications, Volume 39, Issue 16, 2012
49. M. Keil, A. Tiwana, A. Bush Reconciling user and project manager perceptions of IT project risk: a Delphi study Information Systems Journal, 12 (2) (2002), pp. 103-119
50. Marshall, M.N., 1996. The key informant technique. Fam. Pract. 13, 92–97.
51. McClelland, David C. Human Motivation. Glenview, Ill: Scott, Foresman, 1985.
52. McKinley, W. & Mone, M.A.. (2009). Micro and Macro Perspectives in Organization Theory: A Tale of Incommensurability. The Oxford Handbook of Organization Theory. 1-672.
53. Meshkova E.I., Lobov A.A., Мешкова Е. И., Лобов A. A. ИНТЕЛЛЕКТУАЛЬНАЯ СОБСТВЕННОСТЬ КАК АКТИВ БАНКА[Intellectual property as a banking active] // Финансовые рынки и банки. 2022. №3. URL: https://cyberleninka.ru/article/n/intellektualnaya-sobstvennost-kak-aktiv-banka (дата обращения: 20.05.2022).
54. Millerand, F., & Baker, K. S. (2010). Who are the users? Who are the developers? Webs of users and developers in the development process of a technical standard. Information Systems, 137-161.
55. Mircea Georgescu, Victor Jeflea,, The Particularity of the Banking Information System,, Procedia Economics and Finance, Volume 20, 2015, Pages 268-276
56. Norman, D.A.: Emotional Design: Why We Love (or Hate) Everyday Things. Basic Books, New York (2004)
57. Oatley, K., Johnson-Laird, P.N.(1987). Towards of cognitive theory of emotions. Cognition and emotion, 1, 29-50.
58. Oliver, R. L. (1999) ‘Whence Consumer Loyalty?’, Journal of Marketing, 63(4\_suppl1), pp. 33–44.
59. Orlikowski, W.J.: The duality of technology: Rethinking the concept of technology in organizations. Organization science. pp. 398-427 (1992)
60. P.H. Hsu, C. Wang, C. Wu, Banking systems, innovations, intellectual property protections, and financial markets: Evidence from China, Journal of Business Research, 66 (12) (2013), pp. 2390-2396
61. Paul-Olivier Klein, Laurent Weill, Bank profitability and economic growth, The Quarterly Review of Economics and Finance, Volume 84, 2022, Pages 183-199
62. People, Organizational and Technological Dimensions of Software Requirements Specification, Procedia Technology,Volume 5, 2012,Pages 310-318,
63. Robert C. Fuller, Philippe Kruchten, Blurring boundaries: Toward the collective empathic understanding of product requirements, Information and Software Technology, Volume 140, 2021, 106670,ISSN 0950-5849
64. Robertson, J., &amp; Robertson, S. (n.d.). Volere requirements specification template. Volere Requirements. Retrieved May 12, 2022, from https://www.volere.org/templates/volere-requirements specification-template/
65. Rowley, J. (2016). Information marketing. Routledge.
66. Runeson, P., Höst, M., 2009. Guidelines for conducting and reporting case study research in software engineering. Empir. Software Eng. 14 (2), 131–146.
67. S. Yousafzai, M. Yani-de-Soriano, Understanding customer-specific factors underpinning internet banking , adoption, Int. J. Bank Mark., 30 (1) (2012), pp. 60-81
68. Sharma and S. K. Pandey. 2013. Revisiting Requirements Elicitation Techniques. Int. J. Comput. Appl. 75(12): 975-8887.
69. Sharma, S.K. Integrating cognitive antecedents into TAM to explain mobile banking behavioral intention: A SEM-neural network modeling. Inf Syst Front 21, 815–827 (2019).
70. Sutcliffe, A.G., Fickas, S., Sohlberg, M.M.: PC-RE: A Method for Personal and Contextual Requirements Engineering With Some Experience. Requirements Engineering, 11, 157-163 (2006)
71. Sutcliffe, Alistair. (2014). User-oriented requirements engineering. 1-8.
72. Tahir M. Nisar, Caroline Whitehead, Brand interactions and social media: Enhancing user loyalty through social networking sites, Computers in Human Behavior, Volume 62, 2016
73. Tan Lay Hong, Chew Boon Cheong, Hamid Syaiful Rizal, Service Innovation in Malaysian Banking Industry towards Sustainable Competitive Advantage through Environmentally and Socially Practices, Procedia - Social and Behavioral Sciences, Volume 224, 2016, Pages 52-59
74. Thew, S & Sutcliffe, A 2008, Investigating the role of 'soft issues' in the RE process. in Proceedings of the 16th IEEE International Requirements Engineering Conference, RE'08|Proc. IEEE Int. Requir. Eng. Conf., RE. pp. 63-66, 16th IEEE International Requirements Engineering Conference, RE'08, Barcelona, Catalunya, 1/07/08.
75. Tseng, M.M. and Jiao, J. (1998). Computer-aided Requirement Management for Product Definition: A Methodology and Implementation, Concurrent Engineering: Research and Application, 6(2): 145–160.
76. Ullman, D., 2002. The Mechanical Design Process. 3rd ed. New York, NY: McGraw Hill.
77. Valentina Y. Guleva, Alexey Dukhanov, Influence of the External Environment Behaviour on the Banking System Stability, Procedia Computer Science, Volume 51, 2015, Pages 1603-1612
78. Von Hippel, E. (2001). Perspective: User Toolkits for Innovation, Journal of Product Innovation Management, 18(4): 247–257.
79. Wijnhoven, F. (2009), “Information Management: An Informing Approach”, Routledge, New York.
80. Wyer, R.S., Cognitive organization and change: An information processing approach, Erlbaum, Potomac, MD, 1975
81. Wiegers, Karl. (2003). Software Requirements.
82. Y.K. Dwivedi, K. Tamilmani, M.D. Williams, B. Lal, Adoption of M-commerce: examining factors affecting, intention and behaviour of Indian consumers, Int. J. Indian Cult. Bus. Manag., 8 (3) (2014), pp. 345-360
83. Zaichkowsky, Judith. (1985). Measuring the Involvement Construct. Journal of Consumer Research. 12. 341-52. 10.1086/208520.

# **Appendix.**

## **Deep interview questions**

1. Tell us about yourself and your experience.

2. Describe, how does the requirements development conducted from your point of view and practice

3. What problems do you see in current requirements development in a banking context?

4. Let's go through the stages of requirements development, describe which stages are present and highlight their importance. How do you define the image and boundaries of the project? How do you define stakeholders? Who makes decisions about requirements development? What are the techniques and methods for identifying requirements? Do you use user cases? How do you utilize use cases and how effective are they? What quality attributes are most important in a banking context? How do you develop functional requirements? How do you develop non-functional requirements? How are requirements modeled and specified? Do you use prototypes? How is architecture developed? How do you test requirements?

5. Let's take a closer look at the inclusion of the user in the requirements development process, how important is this? How often is it applied? What methods are used to provide user participation? Does the image of the organization affect the collection of requirements from the client view? Consider user psychology, are special techniques present to recognize psychological state of the user? How important are the visual characteristics of a product when testing it with a user? Have you noticed biases or errors of judgment in user responses? How do read user emotions or expressions? How important is user involvement in the product when creating requirements?

6. Importance of organizational context. What business rules, documentation elements most affect the process of creating systems in banking? What external factors influence requirements development outside organizational ones? How often does borrowing from competitors occur and why does this happen?

7. When developing, what is the importance of influencing adjacent systems? How is it taken into account?

1. Chi-Chuan Lee, Xinrui Li, Chin-Hsien Yu, Jinsong Zhao, Does fintech innovation improve bank efficiency? Evidence from China’s banking industry, International Review of Economics & Finance, Volume 74, 2021, Pages 468-483 [↑](#footnote-ref-1)
2. Sharma, S.K. Integrating cognitive antecedents into TAM to explain mobile banking behavioral intention: A SEM-neural network modeling. Inf Syst Front 21, 815–827 (2019). [↑](#footnote-ref-2)
3. Karina Curcio, Tiago Navarro, Andreia Malucelli, Sheila Reinehr, Requirements engineering: A systematic mapping study in agile software development, Journal of Systems and Software, Volume 139,

2018, Pages 32-50 [↑](#footnote-ref-3)
4. D.W. Arner, J.N. Barberis, R.P. Buckley, The evolution of Fintech: A new post-crisis paradigm? University of Hong Kong Faculty of Law Research Paper No. 2015/047, UNSW Law Research Paper No. 2016-62 [↑](#footnote-ref-4)
5. Karina Curcio, Tiago Navarro, Andreia Malucelli, Sheila Reinehr, Requirements engineering: A systematic mapping study in agile software development, Journal of Systems and Software, Volume 139, 2018, Pages 32-50 [↑](#footnote-ref-5)
6. Cho, Juyun. Issues and Challenges of agile software development with SCRUM. Issues in Information System.VOL IX, No. 2. 2008. [↑](#footnote-ref-6)
7. Ebert C. 50 Years of Software Engineering: Progress and Perils. IEEE Software. 2018; 35(5): p. 94-101. [↑](#footnote-ref-7)
8. Millerand, F., & Baker, K. S. (2010). Who are the users? Who are the developers? Webs of users and developers in the development process of a technical standard. Information Systems, 137-161. [↑](#footnote-ref-8)
9. Heinbokel, T., Sonnentag, S., Frese, M., Stolte, W., & Brodbeck, F. C. (1996). Don't underestimate the problems of user-centeredness in software development projects: There are many! Behavior & Information Technology, 226-236 [↑](#footnote-ref-9)
10. Tan Lay Hong, Chew Boon Cheong, Hamid Syaiful Rizal, Service Innovation in Malaysian Banking Industry towards Sustainable Competitive Advantage through Environmentally and Socially Practices, Procedia - Social and Behavioral Sciences, Volume 224, 2016, Pages 52-59 [↑](#footnote-ref-10)
11. Rowley, J. (2016). Information marketing. Routledge. [↑](#footnote-ref-11)
12. Ahmad, M., Abawajy, J., & Kim, T.-h. (2011). Service quality assessment in provision of library services. Science and Technology: Paper presented at the International Conference on U-and E-Service. [↑](#footnote-ref-12)
13. Helmer O. and Rescher N. (1959) On The Epistemology of The Inexact Science, Management Science, Oct. 1959, Vol. 6 Issue 1, pp. 25 - 28 [↑](#footnote-ref-13)
14. Tseng, M.M. and Jiao, J. (1998). Computer-aided Requirement Management for Product Definition: A Methodology and Implementation, Concurrent Engineering: Research and Application, 6(2): 145–160. [↑](#footnote-ref-14)
15. Demirel ST, Das R. Software requirement analysis: research challenges and technical approaches. Proceedings of the 2018 6th International Symposiumon Digital Forensic and Security (ISDFS); March 2018:1–6; IEEE. [↑](#footnote-ref-15)
16. Valentina Y. Guleva, Alexey Dukhanov, Influence of the External Environment Behaviour on the Banking System Stability, Procedia Computer Science, Volume 51, 2015, Pages 1603-1612 [↑](#footnote-ref-16)
17. Afiq Fitri ,Sanctions cut Russia off from global payments infrastructure, TechMonitor, URL: https://techmonitor.ai/policy/digital-economy/sanctions-cut-russia-off-from-global-payments-infrastructure [↑](#footnote-ref-17)
18. A. Giovanis, P. Athanasopoulou, C. Assimakopoulos, C. Sarmaniotis, Adoption of mobile banking services, Int. J. Bank Mark., 37 (5) (2019), pp. 1165-1189 [↑](#footnote-ref-18)
19. P.H. Hsu, C. Wang, C. Wu, Banking systems, innovations, intellectual property protections, and financial markets: Evidence from China, Journal of Business Research, 66 (12) (2013), pp. 2390-2396 [↑](#footnote-ref-19)
20. Meshkova E.I., Lobov A.A., Мешкова Е. И., Лобов A. A. ИНТЕЛЛЕКТУАЛЬНАЯ СОБСТВЕННОСТЬ КАК АКТИВ БАНКА[Intellectual property as a banking active] // Финансовые рынки и банки. 2022. №3. URL: https://cyberleninka.ru/article/n/intellektualnaya-sobstvennost-kak-aktiv-banka (дата обращения: 20.05.2022). [↑](#footnote-ref-20)
21. Abu-Shanab, E., & Pearson, J. (2007). Internet Banking in Jordan: The Unified Theory of Acceptance and Use of Technology (UTAUT) Perspective. Journal of Systems and Information Technology, 78-97. [↑](#footnote-ref-21)
22. Y.K. Dwivedi, K. Tamilmani, M.D. Williams, B. Lal, Adoption of M-commerce: examining factors affecting, intention and behaviour of Indian consumers, Int. J. Indian Cult. Bus. Manag., 8 (3) (2014), pp. 345-360 [↑](#footnote-ref-22)
23. S. Yousafzai, M. Yani-de-Soriano, Understanding customer-specific factors underpinning internet banking , adoption, Int. J. Bank Mark., 30 (1) (2012), pp. 60-81 [↑](#footnote-ref-23)
24. A. Tarhini, M. El-Masri, M. Ali, A. Serrano, Extending the UTAUT model to understand the customers', acceptance and use of internet banking in Lebanon: a structural equation modeling approach, Inf. Technol. People, 29 (4) (2016), pp. 830-849 [↑](#footnote-ref-24)
25. Paul-Olivier Klein, Laurent Weill, Bank profitability and economic growth, The Quarterly Review of Economics and Finance, Volume 84, 2022, Pages 183-199 [↑](#footnote-ref-25)
26. Frandsen, Sanne. (2017). Organizational Image. 10.1002/9781118955567.wbieoc103. [↑](#footnote-ref-26)
27. Wijnhoven, F. (2009), “Information Management: An Informing Approach”, Routledge, New York. [↑](#footnote-ref-27)
28. Mircea Georgescu, Victor Jeflea,, The Particularity of the Banking Information System,, Procedia Economics and Finance, Volume 20, 2015, Pages 268-276 [↑](#footnote-ref-28)
29. F. Paetsch, A Eberlein, F Maurer - “Requirements Engineering and Agile Software Development“, 2003. [↑](#footnote-ref-29)
30. Orlikowski, W.J.: The duality of technology: Rethinking the concept of technology in organizations. Organization science. pp. 398-427 (1992) [↑](#footnote-ref-30)
31. People, Organizational and Technological Dimensions of Software Requirements Specification, Procedia Technology,Volume 5,2012,Pages 310-318, [↑](#footnote-ref-31)
32. Aurum, A., Wohlin, C.: Requirements Engineering: Setting the Context In Engineering and managing software requirements, A. Aurum and C. Wohlin, Editors. Springer-Verlag: Berlin, Germany. [↑](#footnote-ref-32)
33. IEEE Guide for Developing System Requirements Specifications [↑](#footnote-ref-33)
34. Adarsh Kumar Kakar, How does the value provided by a software product and users’ psychological needs interact to impact user loyalty, Information and Software Technology, Volume 97, 2018 [↑](#footnote-ref-34)
35. Tahir M. Nisar, Caroline Whitehead, Brand interactions and social media: Enhancing user loyalty through social networking sites, Computers in Human Behavior, Volume 62, 2016 [↑](#footnote-ref-35)
36. Francisco Liébana-Cabanillas, Juan Sánchez-Fernández, Francisco Muñoz-Leiva, The moderating effect of experience in the adoption of mobile payment tools in Virtual Social Networks: The m-Payment Acceptance Model in Virtual Social Networks (MPAM-VSN), International Journal of Information Management, Volume 34, Issue 2, 2014 [↑](#footnote-ref-36)
37. Oliver, R. L. (1999) ‘Whence Consumer Loyalty?’, Journal of Marketing, 63(4\_suppl1), pp. 33–44. [↑](#footnote-ref-37)
38. Kujala, Sari & Kauppinen, Marjo & Lehtola, Laura & Kojo, Tero. (2005). The role of user involvement in requirements quality and project success. Proceedings of the International Requirements Engineering Conference. 75- 84. 10.1109/RE.2005.72. [↑](#footnote-ref-38)
39. Anol Bhattacherjee, An empirical analysis of the antecedents of electronic commerce service continuance, Decision Support Systems, Volume 32, Issue 2, 2001 [↑](#footnote-ref-39)
40. Lu Zhen, Hai-Tao Song, Jun-Tao He, Recommender systems for personal knowledge management in collaborative environments, Expert Systems with Applications, Volume 39, Issue 16, 2012 [↑](#footnote-ref-40)
41. M. Keil, A. Tiwana, A. Bush Reconciling user and project manager perceptions of IT project risk: a Delphi study Information Systems Journal, 12 (2) (2002), pp. 103-119 [↑](#footnote-ref-41)
42. A.B. Barragáns Martínez, J.J. Pazos Arias, A. Fernández Vilas, J. García Duque, M. López Nores, R.P. Díaz Redondo, Y. Blanco Fernández On the interplay between inconsistency and incompleteness in multi perspective requirements specifications Information and Software Technology, 50 (4) (2008), pp. 296-321 [↑](#footnote-ref-42)
43. Karin Garmer, Sven Dahlman, Lena Sperling, Ergonomic development work: Co-education as a support for user participation at a car assembly plant. A case study, Applied Ergonomics, Volume 26, Issue 6, 1995, Pages 417-423 [↑](#footnote-ref-43)
44. Haines, H.M., Wilson, J.R., 1998. Development of a Framework for Participatory ergonomics. Health and safety Executive Report, 174/1998, London, HMSO for HSE Books. [↑](#footnote-ref-44)
45. Ginzberg, M. J. (1981). Early diagnosis of MIS implementation Failure: Promising results and unanswered questions. Management Science, 459-478. [↑](#footnote-ref-45)
46. Thew, S & Sutcliffe, A 2008, Investigating the role of 'soft issues' in the RE process. in Proceedings of the 16th IEEE International Requirements Engineering Conference, RE'08|Proc. IEEE Int. Requir. Eng. Conf., RE. pp. 63-66, 16th IEEE International Requirements Engineering Conference, RE'08, Barcelona, Catalunya, 1/07/08. [↑](#footnote-ref-46)
47. Sutcliffe, A.G., Fickas, S., Sohlberg, M.M.: PC-RE: A Method for Personal and Contextual Requirements Engineering With Some Experience. Requirements Engineering, 11, 157-163 (2006) [↑](#footnote-ref-47)
48. Sutcliffe, Alistair. (2014). User-oriented requirements engineering. 1-8. 10.1109/UsARE.2014.6890993. [↑](#footnote-ref-48)
49. Norman, D.A.: Emotional Design: Why We Love (or Hate) Everyday Things. Basic Books, New York (2004) [↑](#footnote-ref-49)
50. Oatley, K., Johnson-Laird, P.N.(1987). Towards of cognitive theory of emotions. Cognition and emotion, 1, 29-50. [↑](#footnote-ref-50)
51. Ekman, P.: Basic Emotions. In Dalgleish, T., Power, M. (eds.) Handbook of Cognition and Emotion. Wiley, Chichester (1999) [↑](#footnote-ref-51)
52. McClelland, David C. Human Motivation. Glenview, Ill: Scott, Foresman, 1985. [↑](#footnote-ref-52)
53. Barki, H., & Hartwick, J. (1989). Rethinking the Concept of User Involvement. MIS Quarterly, 53-63. [↑](#footnote-ref-53)
54. H.L. O’Brien, Theoretical perspectives on user engagement, Why Engagement Matters: Cross-Disciplinary ,Perspectives and Innovations on User Engagement with Digital Media, Springer (2016), pp. 1-26 [↑](#footnote-ref-54)
55. Bloch, Peter H. and Marsha L. Richins (1983), "A Theoretical Model for the Study of Product Importance Perceptions," Journal of Marketing. 47 (Summer), 69-81. [↑](#footnote-ref-55)
56. Lalmas, Mounia & O'Brien, Heather & Yom-Tov, Elad. (2014). Measuring User Engagement. [↑](#footnote-ref-56)
57. Heather L. O’Brien, Paul Cairns, Mark Hall, A practical approach to measuring user engagement with the refined user engagement scale (UES) and new UES short form, International Journal of Human-Computer Studies, Volume 112, 2018, Pages 28-39 [↑](#footnote-ref-57)
58. Wyer, R.S., Cognitive organization and change: An information processing approach, Erlbaum, Potomac, MD, 1975 [↑](#footnote-ref-58)
59. Zaichkowsky, Judith. (1985). Measuring the Involvement Construct. Journal of Consumer Research. 12. 341-52. 10.1086/208520. [↑](#footnote-ref-59)
60. Runeson, P., Höst, M., 2009. Guidelines for conducting and reporting case study research in software engineering. Empir. Software Eng. 14 (2), 131–146. http://dx.doi.org/10.1007/s10664-008-9102-8. [↑](#footnote-ref-60)
61. Marshall, M.N., 1996. The key informant technique. Fam. Pract. 13, 92–97. [↑](#footnote-ref-61)
62. Cruzes, D.S., Dybå, T., 2011. Recommended steps for thematic synthesis in software engineering. In: International Symposium on Empirical Software Engineering and Measurement. IEEE, pp. 275–284. [↑](#footnote-ref-62)
63. Abbas, Syed & Alam, Khubaib & Iqbal, Umer & Ajmal, Sahar. (2019). Quality Factors Enhancement of Requirement Engineering: A Systematic Literature Review. 13-135. 10.1109/FIT47737.2019.00013. [↑](#footnote-ref-63)
64. Robert C. Fuller, Philippe Kruchten, Blurring boundaries: Toward the collective empathic understanding of product requirements, Information and Software Technology, Volume 140, 2021, 106670,ISSN 0950-5849 [↑](#footnote-ref-64)
65. D. Pandey, U. Suman, A. K. Ramani, “Impact of Requirement Engineering Practices in Software Development Processes for Designing Quality Software Products”, National Conference on NCAFIS, DAVV, Indore, 2008 [↑](#footnote-ref-65)
66. Von Hippel, E. (2001). Perspective: User Toolkits for Innovation, Journal of Product Innovation Management, 18(4): 247–257. [↑](#footnote-ref-66)
67. Huffman, C. and Kahn, B. (1998). Variety for Sale: Mass Customization or Mass Confusion? Journal of Retailing, 74(4): 491–513. [↑](#footnote-ref-67)
68. D. Leffingwell and D. Widrig, Managing software requirements: a use case approach. Pearson Education, 2003. [↑](#footnote-ref-68)
69. K. Pohl, Requirements engineering: fundamentals, principles, and techniques. Springer Publishing Company, Incorporated, 2010. [↑](#footnote-ref-69)
70. Ali Altalbe, “Software Requirements Management”, King Abdulaziz University, Jeddah, Saudi Arabia, 2015 [↑](#footnote-ref-70)
71. Jianxin (Roger) Jiao and Chun-Hsien Chen, “Customer Requirement Management in Product Development: A Review of Research Issues”, Vol 14, Issue 3, 2006. [↑](#footnote-ref-71)
72. Hussain Ahmad, Azham Hussain, Fauziah Baharom, “Current Challenges of Requirement Change Management”, School of Computing Universiti Utara Malaysia, Kedah, Malaysia [↑](#footnote-ref-72)
73. Inflectra, “Principles of Requirements Engineering or Requirements Management 101”, March 1, 2018. [↑](#footnote-ref-73)
74. McKinley, W. & Mone, M.A.. (2009). Micro and Macro Perspectives in Organization Theory: A Tale of Incommensurability. The Oxford Handbook of Organization Theory. 1-672. [↑](#footnote-ref-74)
75. L. Garicano, Y. Wu, Knowledge, communication, and organizational capabilities, Org. Sci., 23 (5) (2012), pp. 1382-1397 [↑](#footnote-ref-75)
76. A. M. Hickey and A. M. Davis. 2003. Elicitation technique selection: How do experts do it?. Proc. IEEE Int. Conf. Requir. Eng. 2003: 169-178. [↑](#footnote-ref-76)
77. Robertson, J., &amp; Robertson, S. (n.d.). Volere requirements specification template. Volere Requirements. Retrieved May 12, 2022, from <https://www.volere.org/templates/volere-requirements> specification-template/ [↑](#footnote-ref-77)
78. Sharma and S. K. Pandey. 2013. Revisiting Requirements Elicitation Techniques. Int. J. Comput. Appl. 75(12): 975-8887. [↑](#footnote-ref-78)
79. Carmel, Erran & George, Joey & Nunamaker, J.F.. (1995). Examining the process of electronic-JAD. Journal of End User Computing. 7. 13-22. [↑](#footnote-ref-79)
80. Ullman, D., 2002. The Mechanical Design Process. 3rd ed. New York, NY: McGraw Hill. [↑](#footnote-ref-80)
81. Kotonya, G. and Sommerville, I., 1998. Requirements Engineering: Process and Techniques. John Wiley & Sons. [↑](#footnote-ref-81)
82. Brace, William & Cheutet, Vincent. (2011). A Framework to Support Requirements Analysis in Engineering Design. Journal of Engineering Design - J ENGINEERING DESIGN. 23. 1-29. \. [↑](#footnote-ref-82)
83. Brace, William & Cheutet, Vincent. (2011). A Framework to Support Requirements Analysis in Engineering Design. Journal of Engineering Design - J ENGINEERING DESIGN. 23. 1-29. [↑](#footnote-ref-83)
84. B. Kitchenham, L. Pickard and S. L. Pfleeger, "Case studies for method and tool evaluation," in IEEE Software, vol. 12, no. 4, pp. 52-62, July 1995 [↑](#footnote-ref-84)