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## TOWARDS IDENTIFYING CHALLENGES IN BUSINESS ANALYSIS ON IT PROJECTS – A PRACTICAL STUDY

The **subject matter** of this article is business analysis and requirement engineering (BA/RE) in software projects. The **goal** is to identify the challenges faced by Ukrainian business analysts and requirement engineers in software development projects and investigate the possible reasons and negative consequences of these issues. The **tasks** to be solved are: create and conduct a survey on the practices of BA/RE in IT projects, define the most critical problems in BA/RE, their causes and implications, and define how project context influences problems in business analysis and requirement engineering. The **methods** used are: a survey ( $N = 324$ ) was performed among business analysts and requirement engineers in Ukraine regarding problems in BA/RE and the context of IT projects in which they manifest. The Chi-Square test of independence and Cramer's V effect size measure were applied to define statistically significant dependencies between project context and BA/RE problems. The following **results** were obtained: the most critical problems in BA/RE, their causes, and their implications were defined and compared with other comprehensive studies. Twelve statistically significant associations for pairs "project context – BA/RE problem" were found (based on the p-value and Cramer's V effect size measure). **Conclusion:** 1) A comparison of the results of this study with similar studies conducted in other contexts has shown that the issues identified by Ukrainian BA/RE professionals are similar to those found by other researchers in other countries; 2) it is concluded that project context influences particular BA/RE problems, and these dependencies allow us to develop recommendations for risk management for particular problems depending on the project context.

**Keywords:** software requirements engineering; business analysis; problems; project context; practical survey; Chi-square; Cramer V.

### Introduction

Business analysis is the practice of providing opportunities for change in the context of an enterprise's work by identifying needs and recommending solutions that bring value to stakeholders [1]. This discipline broadens the requirements of engineering and its application areas [2, 3]. Depending on the project methodology and solution type, there are differing perspectives on business analysis tasks. All business analysis tasks can be grouped into six knowledge areas: Business Analysis Planning, Elicitation, Requirements Life Cycle Management, Strategy Analysis, Requirements Analysis and Design Definition, and Solution Evaluation [4]. Business analysis is critical for software projects because many failures originate from requirements-related topics, and requirements and solution scope remain the central elements of business analysis [5].

Well-known statistics on project failure because of requirements problems can be found in sources such as CHAOS reports by Standish Group [6], KPMG [7], and PMI surveys. For example, in the survey conducted by PMI [8], the following primary causes of project failures

are mentioned: poor requirements management (47 %), inaccurate requirements gathering (39 %), and inadequate/poor communication (30 %). When setting up a project, many conditions are not transparent enough. However, project peculiarities significantly influence the choice of methods, approaches, and tools in business analysis/requirements engineering (BA/RE) practices. As a result, it is impossible to standardize the approaches so that the BA/RE-related project risks are always minimized.

Considering the facts above, finding new solutions for optimizing BA/RE processes on the project and further assessing their effectiveness is still pertinent. However, the first task is to identify the common problems faced by practitioners in different countries, which requires understanding the ongoing critical BA/RE challenges, their causes, and implications.

It is hardly possible to obtain such information using only theoretical knowledge. Data must be gathered from industry professionals involved in real-world software projects to reflect current practices. Therefore, practical studies grounded in international standards and guides should be conducted on a broad audience, espe-

cially in countries that significantly influence the IT industry's development worldwide. Eastern European countries are the primary tech talent pool for many USA, UK, Europe, and Asia companies. Ukraine is one of the top outsourcing destinations in Eastern Europe, considering the number of IT companies with 5+ years on the market and verified client reviews with high scores [9]. A literature search revealed no related works addressing BA/RE problems in Ukrainian IT projects. As for the studies worldwide, in most of them, the practitioners' view is missing, or there are isolated case studies or small-scale studies investigating aspects that can hardly be generalized. For instance, in [10], only 55 respondents participated in the survey, and most studies involved even fewer participants.

Understanding the current business analysis problems and the project context's impact on them will allow practitioners to increase the efficiency of business analysis tasks due to proactive work with potential risks, considering the specifics of a specific project.

This study describes a questionnaire-based survey study targeting people responsible for BA/RE activities in software projects. The main goal is to identify the challenges that business analysts and requirement engineers face in software development projects, obtain information about possible reasons and negative consequences of the problems, and define how the project context influences these challenges. We studied the experience of 328 practicing specialists from Ukrainian and international companies using a questionnaire, experts' judgment, and statistical analysis.

## 1. Current Research Analysis

Because the research presented in this paper is survey-based, we focused on the related works containing the involvement of practitioners from the IT industry. As this industry and, as a result, related BA/RE processes are evolving quite fast, we reviewed relatively latest publications that more likely reflect reality.

Solemon et al. [11] conducted a study to identify Malaysia's most common RE problems. The sample size was 64 respondents. The RE problems were classified into two groups – organization-based and RE process-based. Project managers and developers participated in the survey. The company's maturity level according to CMMI (Capability Maturity Model Integration) was chosen as the factor whose influence was studied. No correlation was found between the CMMI level and the presence of problems, and the influence of other factors of the project context was not investigated. Jarzebowicz and Slesinski [10] surveyed the Polish IT Industry representatives to identify the most widespread problems/challenges related to requirements. The questionnaire included 64 pre-defined problems elicited from a literature

review and a workshop involving a small group of analysts. It was completed by 55 respondents, each of whom assessed the frequency of occurrence for pre-defined problems and could report additional problems based on their work experience. The top 20 problems were selected and analyzed for a software project context. Only two hypotheses of the influence of the way of work and the team size on the problems were tested, which were not confirmed by statistical methods.

Another ongoing project includes a series of research under the NaPiRE abbreviation. NaPiRE surveys have already included ten countries, and more are expected in further replications. However, the Ukrainian IT industry is not addressed in this project. The first publication of this initiative [12] is devoted to the question of creating a questionnaire and the results of its use in the German IT industry. Representatives of 58 companies took part in the survey. . Characteristic problems of requirements engineering and their characteristics are revealed. In [13], it is mentioned that data were obtained from 228 companies working in 10 countries in various domains. However, the authors mentioned that it was still impossible to estimate the representativeness of the population. What is concerning about the questionnaire used in the study is the insufficient matching of terms and content on international standards, practical guidelines, and bodies of knowledge such as Business Analysis Bodies of Knowledge created by the Institute of Business Analysis (IIBA) [1], Guide to Business Analysis created by Project Management Institute (PMI) [14], materials recommended by International Requirement Engineering Board [15], international ISO/IEC/IEEE standard [16]. The survey results list the top 10 most cited RE problems and the Cause–Effect analysis for them. Within the same NaPiRE initiative, the agile–focused survey was conducted by Wagner et al. based on the second NaPiRE run in 2014/2015 [17]. Data were gathered from 92 companies with Scrum and XP development process models. A list of 22 problems was suggested to the participants and ranked according to the answers. The impact of the project context on the presence of problems was investigated. The study [18] presented the full results of studies of requirements engineering practices based on surveys conducted in 10 countries. The results showed no significant differences between organizations in different countries and regions regarding the existing problems and practices used in projects. The impact of the project context on the use of requirements discovery, analysis, modeling techniques, and other business analysis and requirements engineering tasks was also revealed. The impact of the project context on the presence of business analysis problems was not investigated.

A recent case study by Kasauli et al. [19] was conducted within seven large-scale companies and reported their RE challenges and best practices from the industry

narrowed by the agile methodology. The results are based on 20 qualitative interviews, five focus groups, and eight cross-company workshops. 6 challenging areas and 24 problems were identified for RE in large-scale Agile system development. Also, companies' practices and recommendations from LeSS and SAFe frameworks were compared. The study did not investigate the impact of other factors except for the project implementation approach. In [20], a review of existing research on problems related to requirements engineering in Agile projects is conducted. For each problem, recommendations were made regarding possible approaches to its elimination based on the recommendations of specialized specialists. Thus, each problem was considered not in a general context but as an atomic problem to be solved. Tukur, Umar, and Hassine [21] conducted a systematic mapping study to analyze studies in the area of RE challenges in the literature. They also surveyed 28 IT practitioners from 15 companies in four countries to define the top challenges and check the correlation between RE challenges in the literature and in practice. It was found that practitioners did not recognize some challenges considered in the literature as important challenges. The main limitation of this research is the relatively limited number of survey participants, which can be the reason for biases in the results. Hoy and Xu [22] conducted a systematic literature review regarding requirements engineering processes challenges in Agile projects. The set of most common challenges and possible solutions for them was defined, and a framework for orchestrating agile challenges was formed based on best practices.

The influence of requirement quality characteristics (atomic, completeness, conciseness, feasibility, unambiguousness, testability, prioritized, understandability, and security) on stakeholder satisfaction was analyzed in [23]. A methodology for quantitative assessment of satisfaction with requirements was proposed. The main limitation of the proposed approach is the non-use of weighting coefficients in the procedure for assessing all quality characteristics in different contexts.

Identifying the impact of the project context on the organization of business analysis work in terms of the choice of techniques also remains within the focus of scientific research. The work [24] analyzed and proved the influence of context on the choice of modeling techniques and documentation of software requirements. A framework was proposed in [25] that allows requirements engineers to choose requirements discovery techniques based on the project context. The further development of the idea of analyzing the relationships between the project context and the organization of business analysis work consisted in creating machine learning models that recommended business analysis techniques depending on the project [26]. The study [27] analyzed the influence of organization and environment context on the

project portfolio management approach and the organization's maturity level.

Table 1 contains a summary of the findings from the surveys mentioned above. Further in the paper, we compare our list of problems with those from Table 1.

No fundamental studies were found to determine the current problems, their reasons, and negative consequences related to business analysis in projects for Ukraine's IT industry and the influence of the project context. Therefore, this issue remains unresolved.

Thus, we can conclude that the research direction of the impact of the context on the organization of business analysis works is relevant. The question of the project context's influence on business analysis problems, with confirmation using statistical methods, remains open.

Table 1  
Summary of the top problems in RE identified in practical studies

No.	RE problem	[10]	[18]	[11]
1	Conflicting requirements from different stakeholders/inconsistent requirements	+	+	+
2	Too short time for analysis (timeboxing)	+	+	+
3	Missing requirements traceability	+	+	+
4	Stakeholder low availability/weak access to business information	+	+	
5	Stakeholder describes solution instead of requirements	+	+	
6	Business goals are unmeasurable	+	+	
7	Stakeholders do not express "obvious" requirements/implicit requirements	+	+	
8	The lack of domain knowledge	+	+	
9	Underspecified and not verifiable requirements	+	+	
10	Communication flows within the project team		+	+
11	Ambiguous requirements		+	+
12	Undefined RE process/unclear responsibilities		+	+
13	Unrealistic stakeholder expectations	+		
14	Scope creep	+		
15	Stakeholders ignore business goals and focus on requirements only	+		

Continuation of Table 1

No.	RE problem	[10]	[18]	[11]
16	Stakeholders are unable to express requirements other than change requests to working software	+		
17	No prioritization from stakeholders (all is important)	+		
18	Blind requirements specification acceptance/approval by stakeholder	+		
19	Stakeholders' conflict about requirements priorities	+		
20	Requirements are defined by unauthorized/not appropriate stakeholders	+		
21	Difficult communication with a remote stakeholder	+		
22	No defined process for requirements changes	+		
23	Insufficient support by customer/project lead		+	
24	Weak relationship between customer/project lead		+	
25	Unclear/unmeasurable non-functional requirements		+	
26	Communication flows between developers and customers		+	
27	Incomplete and/or hidden requirements		+	
28	Technically unfeasible requirements		+	
29	Moving targets (changing goals, business processes, and/or requirements)		+	
30	"Gold plating" (implementations of features without corresponding requirements)		+	
31	Application complexity			+
32	Poor user understanding			+

## 2. The purpose and objectives of the research

This paper is aimed at:

- identification of the challenges that Ukrainian Business Analysts/ Requirements Engineers have in software development projects, get information about possible reasons and negative consequences;

- analysis of the influence of different IT project contexts on the problems related to BA/ RE activities;
- comparison of the results with similar studies done in different countries.

To achieve these objectives, the following research questions (RQ) were formulated:

- RQ1: What are the most common requirements-related issues, their roots, and their consequences in the Ukrainian IT industry?
- RQ2: How do different IT project contexts influence reported issues?

In RQ2, "different contexts" mean factors such as project size, company type, and size. The conclusions should be structured according to the tasks set. The conclusions should not contain general information but reflect the research results and prospects for further research in this direction.

## 3. Materials and methods

The object of the study was modern practices of business analysis and requirements engineering in software development projects.

The central research hypothesis is that the project context affects the presence of problems in business analysis and requirements engineering.

### 3.1. Methods of data collection

It was decided to survey practicing business analysts and requirements engineers to gather information about the projects' context and business analysis practices. The questionnaire basis was taken from the NaPiRE initiative [13] and reworked considering such sources as [1, 14–16, 28]. It allowed us to compare the results, i.e., statistics on the same problems, and simultaneously extend the list by other relevant problems. One of the benefits, from our viewpoint, is that the paper authors have both theoretical and practical backgrounds in BA/RE, making it easier to prepare questions that match the reality of software development projects. Survey items were carefully written using business analysis vocabulary, mostly from BABOK. The types of questions used for the questionnaire are open-ended, closed-ended (multiple and single choices), and Likert scale.

The total number of questions was 90; 18 are relevant to this paper's research questions. After several rounds of peer reviews with senior business analysts from DataArt, an international IT consultancy company, the questionnaire was given for validation to business analysis experts from Ukrainian IT industry leaders, who have more than five years of experience in IT Business Analysis and are members of the Ukraine IIBA chapter. Among the comments received as the first feedback were remarks about the time needed to answer the questions (it

took too long to complete the questionnaire) and the complexity of some terms that might cause clarity problems for young professionals. After the recommended improvements were made, cognitive interviews were conducted with ten potential respondents to determine how they interpreted the terms, questions, and answer options. The questionnaire was then ready for distribution.

The target respondents were IT professionals from Ukraine, mainly business analysts and other roles involved in business analysis or requirements engineering activities. English and Ukrainian languages were used for the questionnaires. The questionnaire itself was designed using Google forms. The questionnaire's link was shared in the local Business Analysis communities, professional and social networks, and via personal contacts in the TOP 10 Ukrainian IT companies. The answers were collected within one month. After that, data were merged and coded for further analysis. The following questions' categories were included in the questionnaire:

- Q1: General Information;
- Q2: Requirements Elicitation and Collaboration;
- Q3: Requirements Analysis and Design;
- Q4: Requirements Verification and Validation;
- Q5: Requirements Management;
- Q6: Attitude to Business Analysis in the project;
- Q7: Challenges, Causes, and Effects.

However, only questions from sections "Q1: General Information" and "Q7: Challenges, Causes, and Effects" are relevant to this paper so we will concentrate on them.

Q1: General Information. The section covers the project context and participants' background, which are crucial for analyzing the results obtained for other questionnaire sections, as it helps us get the answer for RQ2.

Questions in this section were intended to give the context, such as:

- project size;
- the industrial sector of the current project. The industrial sectors were taken from [13] and reworked to domain areas where most Ukrainian IT Companies offered services;
  - company type: IT or non-IT. For IT companies, the separation was made among Outstaff, Outsourcing, and Product companies;
  - company size;
  - class of systems or services such as business, embedded, scientific software, etc;
  - team distribution (co-located or dispersed) ;
  - role in the Project;
  - experience in business analyst (BA)/requirements engineer (RE) role;
  - certifications;
  - way of working on the project (adaptive vs. predictive);

- project category for most participant's projects (e.g., greenfield engineering);
- BA/RE activities, in which the respondent is usually involved.

Q7: The questions and answers options in this section are listed below.

The analysis of the answers obtained for this section enables us to obtain the answer for RQ1.

Q 7.1 Considering your personal experience, which issues would you classify as the five most critical ones?

Answer options:

- "gold plating" (implementation of features without corresponding requirements);
- the absence/ignorance of non-functional requirements;
- absence of requirements verification practice;
- ambiguous requirements (allow for various interpretations) ;
- communication flaws between the project and the customer;
- communication flaws within the project team;
- complex (not atomic) requirements;
- formal (insufficient) requirements validation from the customer side;
- incomplete or hidden requirements;
- inconsistent requirements;
- insufficient support by the customer;
- insufficient support by the project lead;
- missing traceability;
- moving targets (changing goals, business processes, and/or requirements);
- poor or non-relevant requirements prioritization;
- stakeholders with difficulties in separating requirements from previously known solution designs;
- technically unfeasible requirements;
- terminological problems;
- timeboxing / not enough time in general;
- unclear/unmeasurable requirements;
- unclear responsibilities;
- weak access to customer needs and/or (internal) business information;
- weak knowledge of the customer's application domain;
- weak relationship between customer and project lead;
- weak requirements change assessment and management.

Q7.2 Considering your personally experienced most critical problems (selected in the previous question), which CAUSES do they have?

Answer options:

- the customer has no clear vision of the product/service;

- disagreement between stakeholders on the client side;
- domain complexity;
- the lack of Business Analysis experience;
- language barriers;
- low stakeholder's interest in the project;
- many external dependencies/3rd party integrations;
- poor project management;
- poor/absent documentation on the existing solution/business process;
- missing direct communication with key stakeholders;
- weak BA hard skills (processes, tools, and techniques, templates, etc.);
- weak BA soft skills (communication, leadership, and conflict management).

Q7.3 Considering your personally experienced most critical problems (selected in the previous question), which IMPLICATIONS do they have?

Answer options:

- breaches of regulatory compliance;
- customer dissatisfaction/loss of trust;
- effort/budget overran;
- failure/difficulties with 3rd party integrations;
- the gap between end-user real needs and implemented functionality;
- low quality of the product/service;
- missing product/service functionality;
- negative user experience due to heavy UI design;
- often/significant code rework;
- project failure (early closure, non-usable product/service, etc.);
- reduced business process efficiency due to poor solution design;
- scope creep;
- wrong project estimates.

Q7.4 Considering your personally experienced difficulties (from the previous question), which causes do they have?

Answer options:

- hot temper;
- introversion;
- lack of time;
- lack of mentoring;
- missing practice;
- none (I had no difficulties).

Q7.6 Considering your personally experienced difficulties in BA underlying competencies, what implications do they have?

Answer options:

- communication problems (with a customer and/or team);
- conflicts and/or project exit;

- inability to identify/solve client's problems;
- no established business analysis process/approach;
- unexpected system effects (undetected dependencies);
- none (I had no difficulties).

### 3.2. Methods of analyzing the dependencies between the project context and problems in business analysis and requirements engineering

The presence of associations between specific contexts and problems was defined based on the Chi-Square test of independence. A set of hypotheses about the association between context and problem presence was developed. The example of the null and alternative hypothesis is:

H0: No association exists between context A and problem B's presence.

H1: There is an association between context A and problem B's presence.

If the P-value is less than 0.05, considering the confidence level of 0.95, it is possible to conclude the statistical significance of the association for the pair "project context"- "problem".

Additionally, it was decided to analyze the occurrence of specific problems in specific contexts. For this reason, clustered bar charts were built showing the distribution of "yes/ no" answers regarding the specific problems in the specific contexts, such as the company type, company size, team distribution, way of working on a project, work experience, project type, and project size.

Standardized Pearson Residual (SPR) was used to interpret the identified dependencies for context-problem pairs. Also, Cramer's V – Chi-square based association measure – was used to adjust the Chi-Square test results and consider differences in table size [29]. The tool used for analysis is IBM SPSS.

## 4. The results of the study of problems in business analysis, their characteristics, and the impact of the project context

### 4.1. Methods of analyzing the dependencies between the project context and problems in business analysis and requirements engineering

After carefully analyzing the survey results, it was decided to eliminate 4 of 328 answers due to their inconsistency or incompleteness [24]. The remaining 324 were considered in the analysis. According to a rough estimate of the statistics available on LinkedIn for Ukraine and on the most famous Ukrainian IT website – DOU.ua, the total number of Business Analysts/ Requirements Engineers in Ukraine is between 5,500 and 7,500 people. The

following formula, proposed in [30], was used to assess the margin of error:

$$e = Z \cdot \sqrt{(p(1-p) / n) \cdot \sqrt{(N-n) / N}}, \quad (1)$$

where n is the sample size (number of survey participants), N is the size of the population, Z is the critical value of the desired confidence level (taken equal to 1.96 for a confidence level of 95 %), e – margin of error, p is the maximum probability of distribution variation (taken equal to 0.5).

Therefore, at a confidence level of 95 %, the study's margin of error is from 5.28 % to 5.33 %, depending on the estimate of the total number of business analysts/requirements engineers in Ukraine, which allows us to conclude that the study is sufficiently representative.

**4.1.1. General information**

The top five industries for which our respondents work include Financial/Banking (25 %), E-commerce and Retail (14 %), Healthcare/ Pharmaceuticals (12 %), ERP systems (8 %), and Media, Advertising & Entertainment (6 %). The vast majority (66 %) of respondents work in IT companies operating according to the outstaffing or outsourcing model; the rest are separated between IT product companies (18 %) and non-IT companies (16 %). Additionally, more than half of these companies (52 %) are large, having more than 200 employees, 29 % are medium-sized, and 19 % are small. Almost 2/3 (63 %) of respondents work in distributed teams; others work in collocated teams. Development from scratch is the general category of projects our respondents are involved in (43 %), followed by reengineering (28 %) and product/ platform customization (20 %) projects. At the same time, 41 % of the projects mentioned above involve up to 15 members maximum, 27 % – up to 30 members, 19 % – up to 100 members, and only 13 % – over 100 members. The most used way of working on the project among our respondents is Agile/ Lean (59 %) compared to only 15 % working in the good old plan-driven approach (Waterfall, RUP, etc.). And lastly, more than a third (36 %) of survey respondents have worked as Business Analysts/ Requirements Engineers for less than three years, 22 % – from 3 to 5 years, 26 % – from 5 to 10 years, and nearly 16 % – more than ten years.

**4.2.2. Problems, causes, and effects**

Survey results for the section “Q7: Problems, Causes, and Effects” are presented in Table 2–4 ranking the most critical problems, their causes, and effects that Ukrainian Business Analysts/ Requirements Engineers

have to deal with. Percentage of the total number of responses was used to represent the frequency of a particular problem/cause/ effect.

Problems-related responses in Table 2 reveal that the most frequent problem is “moving targets (goals/ processes/ requirements)” – 43 % of votes were given to it. “Incomplete or hidden requirements” holds second place with 41 %, followed by “insufficient access to customer needs and/or (internal) business information” with 33 %.

Table 2

The most critical problems

Problem	%
Moving targets (changing goals, business processes and/or requirements)	43
Incomplete or hidden requirements	41
Weak access to customer needs and/or (internal) business information	33
The absence / ignorance of non-functional requirements	27
Formal (insufficient) requirements validation from the customer side	27
Inconsistent requirements	27
Time boxing / Not enough time in general	27
Communication flaws between the project and the customer	26
Stakeholders with difficulties in separating requirements from previously known solution designs	24
Unclear responsibilities	24
Ambiguous requirements (allow for various interpretations)	23
Insufficient support by customer	21
Communication flaws within the project team	18
Missing traceability	18
"Gold plating" (implementation of features without corresponding requirements)	17
Absence of requirements verification practice	17
Weak knowledge about customer's application domain	17
Weak requirements changes assessment and management	16
Unclear/unmeasurable requirements	13
Poor or non-relevant requirements prioritization	12
Complex (not atomic) requirements	11
Technically unfeasible requirements	8
Terminological problems	8
Weak relationship between customer and project lead	8
Insufficient support by project lead	4

“Time boxing”, “inconsistent requirements”, “formal (insufficient) requirements validation from the customer side”, and “the absence/ ignorance of non-functional requirements” have an equal number of votes (27 % each), closing the top of the most common problems from Ukrainian Business Analysts/ Requirements Engineers’ experience. Less frequent problems include “insufficient support by project lead”, “terminological issues”, “weak relationship between customer and project lead”, and “technically unfeasible requirements”.

As for the causes of critical problems highlighted by Ukrainian Business Analysts/ Requirements Engineers, survey results (Table 3) are as follows: “Missing direct communication with key stakeholders” (70 %), “The customer has no clear vision about the product/service” (62 %), “Disagreement between stakeholders on the client side” (43 %), “Poor/absent documentation on the existing solution/business process” (38 %) and “Many external dependencies/3rd party integrations” (36 %). This top 5 list suggests that Business Analysts/ Requirements Engineers need to fight for access to key persons from the customer’s side, explaining why this type of communication is the key to the success of the product/ service, pay more attention during problem statement and scope definition as part of the pre-project analysis and the course of the project; constantly develop domain knowledge and communication skills.

Table 3

Causes of most critical problem

Causes	%
Missing direct communication with key stakeholders	70
The customer has no clear vision about the product/service	62
Disagreement between stakeholders on the client side	43
Poor/absent documentation on the existing solution/business process	38
Many external dependencies/3rd party integrations	36
Poor project management	33
Low stakeholders interest in the project	32
The lack of Business Analysis experience	25
Domain complexity	23
Weak BA soft skills (communication, leadership, and conflict management)	19
Weak BA hard skills (processes, tools and techniques, templates, etc.)	17
Language barriers	8
Low Level of stakeholder culture understanding by BA	1

Among the consequences of the above-mentioned critical problems, the respondents singled out the following top 5 (Table 4): “Effort/budget overran” (59 %) and

“Wrong project estimates” (54 %), “scope creep” (58 %), “Project failure (early closure, non-usable product/service, etc.)” (48 %), “Gap between end-user real needs and implemented functionality” (45 %).

#### 4.3. Impact of IT project context on problems related to BA/RE activities

Clustered bar charts were constructed to visualize the statistically significant relationships between the project context and the problems. They show the distribution of yes/no responses to a specific problem in specific contexts, such as company type, company size, team distribution, and project approach. (Figures 1–12). The represented charts were built only for context–problem pairs with strong associations [30].

Table 4

Implications of most critical problems

Implications	%
Effort/budget overran	59
Scope creep	58
Wrong project estimates	54
Project failure (early closure, non-usable product/service, etc. )	48
Gap between end-user real needs and implemented functionality	45
Often/significant code rework	40
Customer dissatisfaction/loss of trust	39
Missing product/service functionality	23
Low quality of the product/service	22
Failure/difficulties with 3rd party integrations	20
Reduced business process efficiency due to poor solution design	17
Negative user experience due to heavy UI design	16
Breaches of regulatory compliance	4

The problem of inconsistent requirements is associated with two contexts, as Fig. 1 and Fig. 2 show: the project category and the work experience. The project category “User interface engineering” received the highest 25 % or 7 out of 28 responses claiming the presence of the “inconsistence requirements” problem. “Product/platform customization” and “Reengineering” categories received 16.92 % or 11 out of 65 responses and 16.67 % or 15 out of 90 responses, respectively. The “Greenfield engineering” category, which has the most significant number of respondents, got the lowest 7.8 % or 11 out of 141 responses.

The less experienced Business Analysts/ Requirements Engineers are the ones who face the problem with inconsistent requirements more often – 20.51 % or 24 out



of 117 responses. Interestingly, the most experienced specialists (over ten years) have shown 11.76 % with 6 out of 51 responses.

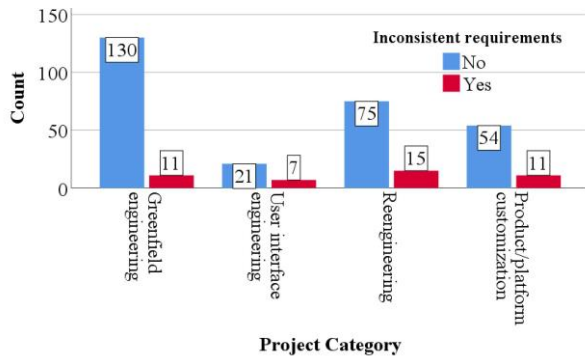


Fig. 1. The distribution of answers regarding the problem of “Inconsistent requirements” depending on the project category (CRAMER–V = 0.162)

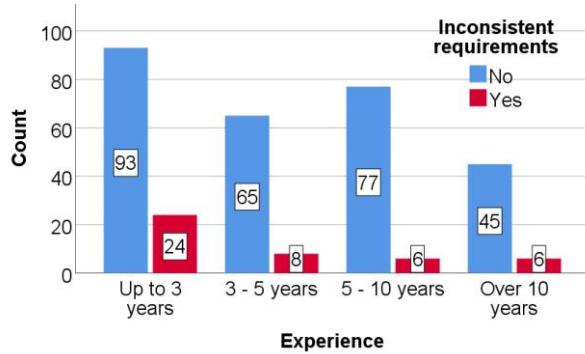


Fig. 2. The distribution of answers regarding the problem of “Inconsistent requirements” depending on the work experience (CRAMER–V = 0.159)

The problem of “Weak access to customer needs and/or (internal) business information” is also associated with two different contexts: the type of a company (Fig. 3) and the team distribution (Fig. 4). This problem is common for employees of an IT, Outstaff/ Outsource type of a company – 39.15 % or 83 out of 212 responses, and for distributed teams – 39.41 % or 80 out of 203 responses.

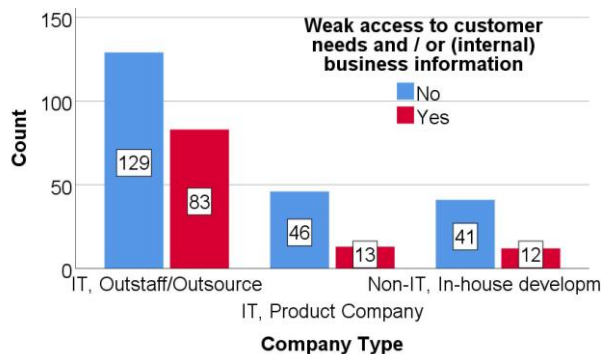


Fig. 3. The distribution of answers regarding the problem of “Weak access to customer needs and/or (internal) business information” depending on the type of company (CRAMER–V = 0.170)

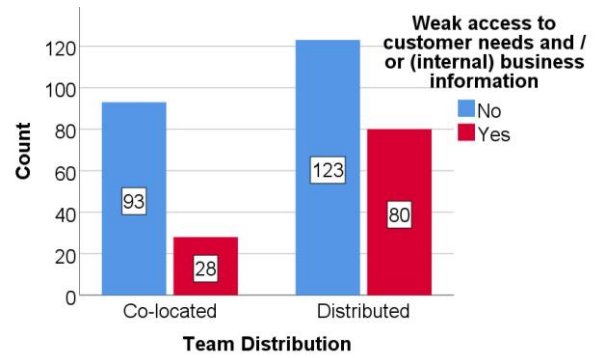


Fig. 4. The distribution of answers regarding the problem of “Weak access to customer needs and/or (internal) business information” depending on the team distribution (CRAMER–V = 0.167)

Survey results also showed that the problem of “Weak requirements changes assessment and management” is associated with the way of working in the project (Fig. 5). Thus, 29.17 % (14 out of 48 responses) of respondents working using a Plan–driven approach face this problem, in comparison with only 11.58 % (22 out of 190 responses) working using Agile methodology.

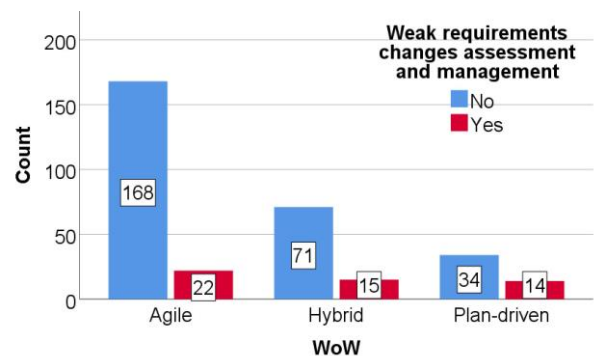


Fig. 5. The distribution of answers regarding the problem of “Weak requirements changes assessment and management” depending on the way of working in the project (CRAMER–V = 0.168)

Work experience influences the problem of “Insufficient support by customer” (Fig. 6). The distribution here is as follows: the least experienced respondents reported the occurrence of this problem in 13.68 % or 16 out of 117 responses, respondents with 3 to 5 years of experience in 17.81 % or 13 out of 73 responses, 5 to 10 years – in 30.12 % or 25 out of 83 responses, and the most experienced – in 25.49 % or 13 out of 51 responses.

The project category, except for the already mentioned problem, also influences the following problems: “Gold plating”, “Communication flaws within the project team”, and “Insufficient support by project lead” (Fig. 7 – 9). At the same time, “Gold plating” most frequently appears in the Greenfield engineering projects – 25.53 % or 36 out of 141 responses, “Communication

flaws within the project team” in the Product/ platform customization projects – 26.15 % or 17 out of 65 responses, and “Insufficient support by project lead” in the Reengineering projects – 10.00 % or 9 out of 90 responses.

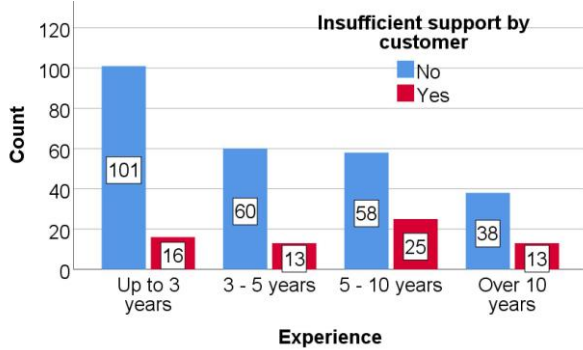


Fig. 6. The distribution of answers regarding the problem of “Insufficient support by customer” depending on the work experience (CRAMER–V = 0.168)

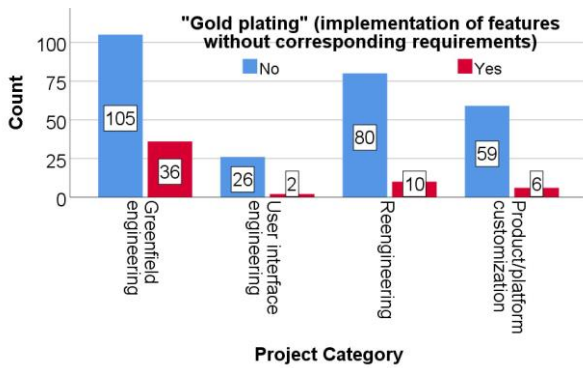


Fig. 7. The distribution of answers regarding the problem of “Gold plating (implementation of features without corresponding requirements)” depending on the project category (CRAMER–V = 0.211)

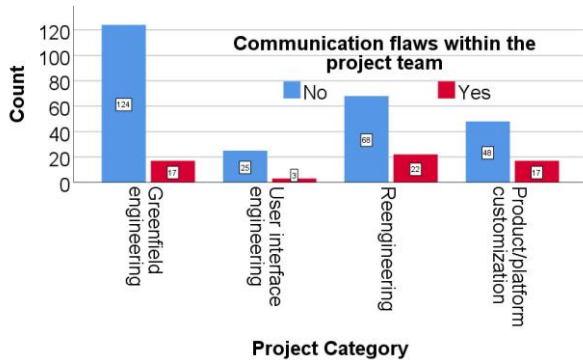


Fig. 8. The distribution of answers regarding the problem of “Communication flaws within the project team” depending on the project category (CRAMER–V = 0.173)

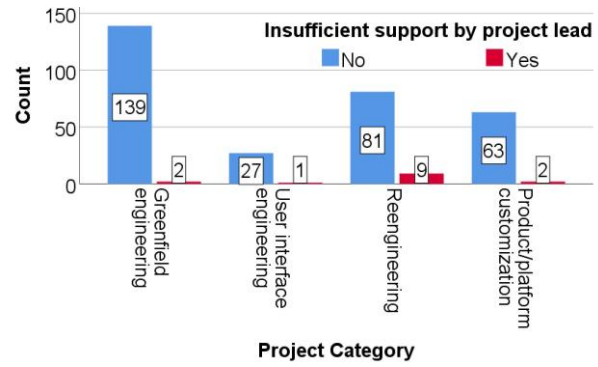


Fig. 9. The distribution of answers regarding the problem of “Insufficient support by project lead” depending on the project category (CRAMER–V = 0.177)

Project size also influences several problems, such as: “The absence/ignorance of non–functional requirements” (Fig. 10), “Complex (not atomic) requirements” (Fig. 11), and “Unclear responsibilities” (Fig. 12). The most influenced by this context in the case of “The absence/ignorance of non–functional requirements” are projects with 15 to 30 members – 37.93 % (33 out of 87 responses), in case of “Complex (not atomic) requirements” – projects with over 100 members (26.19 % or 11 out of 42 responses), and in case of “Unclear responsibilities” – projects with the minimum stated number of members (30.08 % or 40 out of 133 responses).

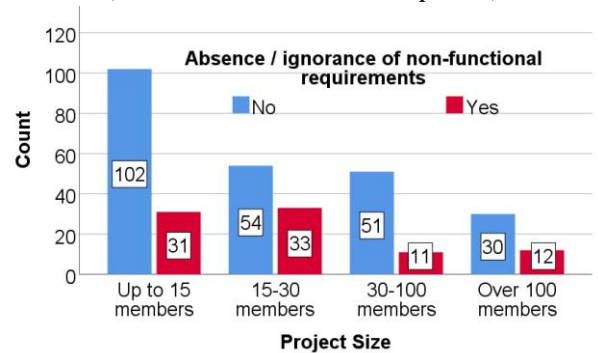


Fig. 10. The distribution of answers regarding the problem of “The absence/ignorance of non–functional requirements” depending on the project size (CRAMER–V = 0.166)

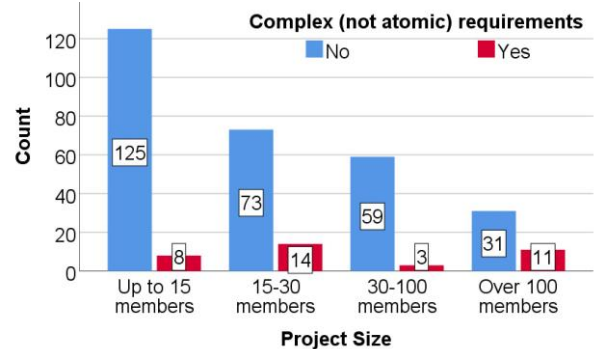


Fig. 11. The distribution of answers regarding the problem of “Complex (not atomic) requirements” depending on the project size (CRAMER–V = 0.235)

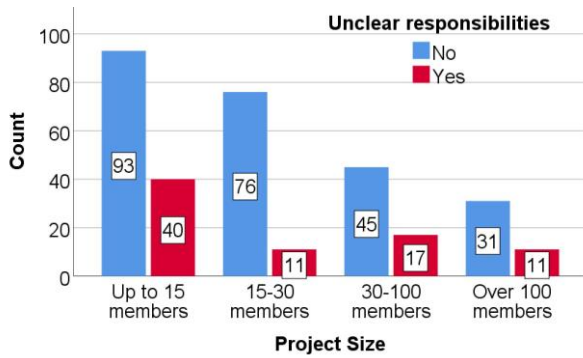


Fig. 12. The distribution of answers regarding the problem of “Unclear responsibilities” depending on the project size (CRAMER-V = 0.169)

### 5. Discussion of the results

Obtained survey results enable us to compare a list of requirements-related problems in the Ukrainian context with those in other countries specified in related works (Section 2). Even though direct comparison in some cases [10, 11] is impossible due to different approaches in definitions of the problems, we can still match the problems in terms of general meaning.

Table 5 shows the results of a comparison of the results in terms of business analysis problems with papers [10, 11, 13]. The comparison is made for the ten most relevant problems that scored 24 % or more within the framework of this study.

Because problems definitions from [18] were mainly used as a basis for our survey, there are many intersections with our study. However, it should be noted that [18] is focused only on problems that occur in Agile projects, whereas our study also represents Hybrid and Plan-driven projects. Ukrainian Business Analysts/ Requirements Engineers often experience the same problems, such as “Moving targets”, “Incomplete or hidden requirements”, and “Inconsistent requirements”. However, less frequent for [18] and more frequent in our case are “Weak access to customer needs and/or (internal) business information” and “Time boxing”.

In the case of Jarzebowicz et al. [10], we can state the same bunch of problems with stakeholders, in particular: “Stakeholders do not express ‘obvious’ requirements” versus “Incomplete and/or hidden requirements”, “Stakeholders’ low availability” versus “Weak access to customer needs and/or (internal) business information” and “A stakeholder accepts specified requirements, which he/ she had not read or comprehend” versus “Formal (insufficient) requirements validation from the customer side”. Furthermore, common problems also are “Scope creep” versus “Moving targets” and “Too short time for analysis available” versus “Time boxing”.

Table 5

Comparison of studies’ results. Most important problems

Problem	%	[10]	[13]	[11]
Moving targets (changing goals, business processes and/or requirements)	43	+	+	-
Incomplete or hidden requirements	41	+	+	+
Weak access to customer needs and/or (internal) business information	33	+	-	+
The absence/ignorance of non-functional requirements	27	-	+	-
Formal (insufficient) requirements validation from the customer side	27	+	+	-
Inconsistent requirements	27	+	+	+
Time boxing / Not enough time in general	27	+	-	+
Communication flaws between the project and the customer	26	+	+	+
Stakeholders with difficulties in separating requirements from previously known solution designs	24	+	+	+
Unclear responsibilities	24	-	+	+

In Solemon et al. [11], while problem identification, in contrast to our study, the CMMI maturity levels of the companies taking part in the survey were analyzed. However, there are still common problems for both studies. Also, [11] divides problems into organizational and RE process-based groups. The latter group has the highest correspondence of problems, specifically: “Incomplete requirements” versus “Incomplete or hidden requirements”, “Poor user understanding” versus “Weak access to customer needs”, “Poor time and resource allocations” versus “Time boxing” and “Inconsistent requirements”. From the Organizational-based group, according to [11], “Lack of defined responsibility” versus “Unclear responsibilities” should be mentioned.

### Conclusions

This paper represents an analysis of the results of a questionnaire-based study aimed at identifying the main challenges Ukrainian Business Analysts/ Requirements Engineers face in software development projects, their causes, and consequences, as well as an analysis of the possible influence of the context-related factors (project

size, company type & size, etc.) on the reported issues. In total, 324 responses from Ukrainian BA/RE professionals were considered in the analysis.

Conclusions that can be made based on the study results are the following: the top three most frequent problems are “moving targets (goals/ processes/ requirements)”, “incomplete or hidden requirements,” and “insufficient access to customer needs and/or (internal) business information”. Among the causes of critical problems highlighted by Ukrainian Business Analysts/ Requirements Engineers are: “Missing direct communication with key stakeholders”, “The customer has no clear vision about the product/service”, and “Disagreement between stakeholders on the client side”. As for the consequences of the above-mentioned critical problems, the respondents singled out the following top three: “Effort/budget overrun”, “Wrong project estimates”, and “scope creep”. Identified most common problems, causes, and conclusions should be considered during risk assessment and mitigation plans should be developed to reduce relevant risks.

What’s more, analysis of occurrence of the specific problems in the specific contexts has shown that there are associations for the following context – problem pairs: the problem of “Inconsistent requirements” and “Project category”, the problem of “Inconsistent requirements” and “Work experience”, the problem of “Weak access to customer needs and/or (internal) business information” and “Type of a company”, the problem of “Weak access to customer needs and/or (internal) business information” and “Team distribution”, the problem of “Weak requirements changes assessment and management” and “Way of working in the project”, the problem of “Insufficient support by customer” and “Work experience”, the problem of “Gold plating” and “Project category”, the problem of “Communication flaws within the project team” and “Project category”, the problem of “Insufficient support by project lead” and “Project category”, the problem of “The absence / ignorance of non-functional requirements” and “Project size”, the problem of “Complex (not atomic) requirements” and “Project size”, the problem of “Unclear responsibilities” and “Project size”. As a result, we can make the following recommendations for business analysts and project managers regarding the higher risk of particular problems depending on the project context:

- “Moving targets (goals/ processes/ requirements)” and “Incomplete or hidden requirements” in all projects;
- “Inconsistent requirements” in user interface engineering projects and a case of a less experienced business analyst;
- “Weak access to customer needs and/or (internal) business information” in Outstaff/Outsource companies and distributed teams;

- “Weak requirements changes assessment and management” in projects implemented according to a plan-driven approach;
- “Gold plating” in Greenfield engineering projects;
- “Communication flaws within the project team” in the Product/platform customization projects;
- “Insufficient support by project lead” in the Reengineering projects;
- “Unclear responsibilities” in the projects with the minimum stated number of members (till 15 members);
- “Complex (not atomic) requirements” in projects with more than 100 members;
- “The absence/ignorance of non-functional requirements” are projects with up to 30 members.

Comparison of this study's results with similar studies has shown that Ukrainian BA/RE-related problems have much in common with the problems identified by other researchers in other contexts: “Moving targets”, “Incomplete or hidden requirements”, and “Inconsistent requirements”, etc.

It should also be noted that war conditions in Ukraine significantly expanded the practice of distributed teams. This increases the risk of the problem “Weak access to customer needs and/or (internal) business information”. The risk of problems “Communication flaws within the project team” and “Missing direct communication with key stakeholders” is also increased, as well as the risk of implications such as “Customer dissatisfaction/loss of trust” and “Project failure (early closure, non-usable product/service, etc. )” for reasons not related to business analysis.

Since obtained results shed light on the interconnection between problems Ukrainian Business Analysts/ Requirements Engineers face, their causes, and consequences for IT projects, it enables us to analyze further how to mitigate problems and preventively deal with rooting causes. This analysis can be conducted in cooperation with experts, resulting in a standard guide with recommendations adopted for different contexts. As another direction for future work grounded on this study, we foresee conducting a more extensive study on this topic with a broader range of respondents from different countries. The conclusions should be structured according to the tasks set. The conclusions should not contain general information but reflect the research results and prospects for further research in this direction.

**Contributions of authors:** conceptualization, methodology – **Denys Gobov**; formulation of tasks, analysis – **Denys Gobov, Olha Titlova**; development of model, software, verification – **Denys Gobov**; analysis

of results, visualization – **Olha Titlova**; writing – original draft preparation - **Olha Titlova**; writing – review and editing – **Denys Gobov**.

All the authors have read and agreed to the published version of the manuscript.

## References

- 1 IIBA. *A Guide to the Business Analysis Body of Knowledge (BABOK Guide)*. Toronto, Ontario, Canada, International Institute of Business Analysis Publ., 2015. 512 p.
- 2 Rubens, J. Business analysis and requirements engineering: the same, only different? *Requirements Engineering*, 2007, vol. 12, iss. 2, pp. 121–123. DOI: 10.1007/s00766–007–0043–3.
- 3 Aoyama, M. Bridging the requirements engineering and business analysis toward a unified knowledge framework. *Advances in Conceptual Modeling: ER 2016 Workshops*, Gifu, Japan, November 14–17, 2016, Proceedings 35, pp. 149–160. Springer International Publishing. DOI: 10.1007/978-3-319-47717-6\_13.
- 4 Gobov, D., Maliarcuk, C., Kunanets, N. & Oliinyk, Y. Approaches for the Concept" Business Analysis" Definition in IT Projects and Frameworks". *CEUR Workshop Proceedings*, 2020, vol. 2711, pp. 321–332.
- 5 Gobov, D. & Yanchuk, V. Network Analysis Application to Analyze the Activities and Artifacts in the Core Business Analysis Cycle, *2nd International Informatics and Software Engineering Conference (IISEC)*, 2020, pp. 1–6. DOI: 10.1109/IISEC54230.2021.9672373.
- 6 *KPMG*. Available at: <https://assets.kpmg.com/content/dam/kpmg/pdf/2009/12/Global-IT-Project-Management-Survey-0508.pdf> (accessed 10.01.2022).
- 7 Langley, M. A. *Success Rates Rise: Transforming the high cost of low performance. Pulse of the Profession*, Project Management Institute, 2017. 32 p.
- 8 *Top IT Outsourcing Companies in Ukraine – 2023 Reviews*. Available at <https://clutch.co/it-services/ukraine>. (accessed 10.01.2022).
- 9 Jarzębowski, A. & Ślesięński, W. What is troubling IT analysts? A survey report from Poland on requirements-related problems. *Engineering Software Systems: Research and Praxis*, 2019, vol. 830, pp. 3–19. DOI: 10.1007/978-3-319-99617-2\_1.
- 10 Solemon, B., Sahibuddin, S. & Ghani, A. Requirements engineering problems and practices in software companies: An industrial survey", *Advances in Software Engineering: International Conference on Advanced Software Engineering and Its Applications, ASEA 2009*, Jeju Island, Korea, December 10–12, 2009, pp. 70–77. Springer Berlin Heidelberg. DOI: 10.1007/978-3-642-10619-4\_9.
- 11 Fernández, D. & Wagner, S. Naming the pain in requirements engineering: A survey design and German results. *Software Engineering*, 2016, vol. 57, pp. 616–643. DOI: 10.1016/j.infsof.2014.05.008.
- 12 Fernández, D. M., Wagner, S., Kalinowski, M., Felderer, M., Mafra, P., Vetrò, A., et al. Naming the pain in requirements engineering: Contemporary problems, causes, and effects in practice, *Empirical software engineering*, 2017, vol. 22, pp. 2298–2338. DOI: 10.1007/s10664–016–9451–7.
- 13 ISO/IEC/IEEE. *Systems and software engineering—Life cycle processes—Requirements engineering*, 2011. DOI: 10.1109/ieeestd.2011.6146379.
- 14 Paton, L. *The PMI Guide to BUSINESS ANALYSIS*. USA, Newtown Square, Pennsylvania, PMI, 2017. 444 p.
- 15 Pohl, K. *Requirements engineering: fundamentals, principles, and techniques*. Springer Publishing Company, Incorporated, 2010. 813 p.
- 16 Wagner, S., Fernández, D. M., Felderer, M. & Kalinowski, M. Requirements engineering practice and problems in agile projects: results from an international survey. *arXiv:1703.08360*, 2016. DOI: 10.7287/peerj.preprints.2038v1.
- 17 Wagner, S., Fernández, D. M., Felderer, M., Vetrò, A., Kalinowski, M., Wieringa, et. al. Status quo in requirements engineering: A theory and a global family of surveys. *ACM Transactions on Software Engineering and Methodology (TOSEM)*, 2017, vol. 28, iss. 2, pp. 1–48. DOI: 10.1145/3306607.
- 18 Kasauli, R., Knauss, E., Horkoff, J., Liebel, G., & de Oliveira Neto, F. G. Requirements engineering challenges and practices in large-scale agile system development. *Journal of Systems and Software*, 2021, vol. 172, article no. 110851. DOI: 10.1016/j.jss.2020.110851.
- 19 Rasheed, A., Zafar, B., Shehryar, T., Aslam, N. A., Sajid, M., Ali, et.al. Requirement engineering challenges in agile software development. *Mathematical Problems in Engineering*, 2021, vol. 1, pp. 1–18. DOI: 10.1155/2021/6696695.
- 20 Tukur, M., Umar, S. & Hassine, J. Requirement engineering challenges: A systematic mapping study on the academic and the industrial perspective. *Arabian Journal for Science and Engineering*, 2021, vol. 46, pp. 3723–3748. DOI: 10.1007/s13369-020-05159-1
- 21 Hoy, Z., Xu, M. Agile Software Requirements Engineering Challenges-Solutions—A Conceptual Framework from Systematic Literature Review. *Information*, 2023, vol. 14, iss. 6, article no. 322. DOI: 10.3390/info14060322.
- 22 Strielkina, A. & Tetskyi, A. Methodology for assessing satisfaction with requirements at the early stages of the software development process. *Radioelectronic and Computer Systems*, 2023, vol. 1, pp. 197–206. DOI: 10.32620/reks.2023.1.16.

23 Gobov, D. & Huchenko, I. Modern Requirements Documentation Techniques and the Influence of the Project Context: Ukrainian IT Experience. *Lecture Notes on Data Engineering and Communications Technologies*, 2021, vol. 134, pp. 260-270. DOI: 10.1007/978-3-031-04812-8\_22.

24 Carrizo, D., Dieste, O. & Juristo, N. Systematizing requirements elicitation technique selection. *Information and Software Technology*, 2014, vol. 56, iss. 6, pp. 644-669. DOI: 10.1016/j.infsof.2014.01.009.

25 Gobov, D. & Huchenko, I. Influence of the software development project context on the requirements elicitation techniques selection. *Lecture Notes on Data Engineering and Communications Technologies*, 2021 vol. 83, pp. 208-218. DOI: 10.1007/978-3-030-80472-5\_18.

26 Kononenko, I., Kpodjedo, M., Morhun, A. & Oliinyk, M. Information technology for choosing the project portfolio management approach and the optimal level of maturity of an organization. *Radioelectronic and Computer Systems*, 2022, vol. 4, pp. 173-190. DOI: 10.32620/reks.2022.4.14.

27 Cadle, J., Paul, D. & Turner, P. *Business analysis techniques: 72 essential tools for success*. BCS, The Chartered Institute, 2010. 288 p.

28 Rea, L. M., & Parker, R. A. *Designing and conducting survey research: A comprehensive guide*. John Wiley & Sons, 2014. 352 p.

29 Cochran, W. G. *Sampling techniques (2nd ed.)*. John Wiley and Sons Inc, 1963. 413 p.

30 Gobov, D. Practical Study on Software Requirements Specification and Modelling Techniques. *International Journal of Computing*, 2023, vol. 22, iss. 1, pp. 78-86. DOI: 10.47839/ijc.22.1.2882.

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## ПРОБЛЕМИ БІЗНЕС-АНАЛІЗУ В ІТ-ПРОЄКТАХ – ПРАКТИЧНЕ ДОСЛІДЖЕННЯ

Денис Гобов, Ольга Тітлова

Предметом дослідження в статті є бізнес-аналіз та розробка вимог (BA/RE) у проєктах по розробці програмного забезпечення. Метою роботи є виявлення проблем, з якими стикаються українські бізнес-аналітики та інженери вимог у проєктах розробки програмного забезпечення, та дослідження можливих причин і негативних наслідків цих проблем. У статті вирішуються наступні завдання: створити опитувальник та провести опитування щодо практик BA/RE в ІТ-проєктах, визначити найбільш критичні проблеми в BA/RE, їх причини та наслідки, а також визначити, як контекст проєкту впливає на проблеми в бізнес-аналізі та розробці вимог. Використовуються такі методи: опитування (N = 324) для збору інформації серед бізнес-аналітиків та інженерів вимог в Україні щодо проблем у BA/RE та контексту ІТ-проєктів, у яких вони проявляються. Для визначення статистично значущих залежностей між контекстом проєкту та проблемами BA/RE було застосовано тест Хі-квадрат незалежності та міру Крамера V. Було отримано наступні результати: визначено найбільш критичні проблеми в BA/RE, їх причини та наслідки, проведено порівняння з іншими комплексними дослідженнями. Було знайдено 12 статистично значущих асоціацій для пар «контекст проєкту – проблема BA/RE» (на основі р-значення та ефекту V Крамера). Висновок: Порівняння результатів цього дослідження з аналогічними дослідженнями, проведеними в інших контекстах, показало, що проблеми, визначені українськими фахівцями BA/RE, досить подібні до тих, які виявили інші дослідники для інших країн. Зроблено висновок, що контекст проєкту впливає на конкретні проблеми BA/RE, і ці залежності дозволяють сформулювати рекомендації щодо управління ризиками для конкретних проблем залежно від контексту проєкту.

**Ключові слова:** розробка вимог до програмного забезпечення; бізнес-аналіз; проблеми; контекст проєкту; практичне дослідження; хі-квадрат; V Крамера.

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