Requirements Gathering for Specialized Information Systems in Public Administration

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Abstract— **Identification of quality requirements is a necessary prerequisite for the development of a functional information system, collection, and analysis of data requirements and data functionalities are the initial steps in the general process of information system development. The quality of the process of collecting and evaluating requirements is a fundamental prerequisite for the created information system to accurately support the work needs of users. Users are therefore interested in participating in this requirements collection process. However, the situation is different for information systems in public administration, the aim of which is regulation and restriction. Here, the reluctance of users to cooperate and pass on the information needed for further development of the system can be assumed. This can then be reflected in the malfunction of the information system in the sense of incorrect support in the enforcement of regulation or restriction by the public administration. The article deals with the process of collecting and evaluating requirements for the restriction targeted information systems.**

Keywords— *information system; voice of user; requirements gathering; support tools*

I.   INTRODUCTION

An information system is composed of people/users, hardware, software, database(s), application programs, and business processes. An information system is designed to facilitate the transformation of data into information and to manage both data and information [1]. Company management perceives information systems and information services generally as a necessary part of the business processes and expects their continuous performance. The degree of requirements on information environment in an organization is directly proportional to the economic and operational needs of the company; at the same time, it is determined by progress and abilities of information and communication technologies. The main goals are [2]:

- to ensure high functionality of information system; this means not only functions of keeping records and transactions but also analytic, functions for decision support and control functions;

- to achieve a high rate of application and technological availability, i.e. security, accessibility, reliability, and flexibility;

- to monitor continuously minimization of the cost compared to economic and non-economic effects.

Information systems in public administration have a specific position. The introduction of information systems into public administration activities in the Czech Republic is defined in Act No. 365/2000 Coll., (Act on information systems of public administration and amending certain other acts, as amended) [3] [4]. The Information Strategy of the Czech Republic focuses on digitization in the area of the exercise of official authority at the national level. It sets out the main objectives concerning the building of public administration information systems and also sets out general principles of the administration and operation of public administration information systems. The information system in public administration is determined to serve as support for ensuring the performance of public administration [5]. The information system in public administration is to some extent specific because it participates in the fulfillment of obligations arising from the powers of public administration bodies and at the same time stores data and information on the fulfillment of these obligations.

II.   FORMULATION OF THE PROBLEM

The development of each information system takes place by the defined requirements, resp. development significantly depends on how comprehensively and correctly the requirements have been defined.

A requirement is any assumption or capability of a system that can help a participant (system user) solve a problem or achieve a goal. At the same time, the requirement is the assumption or capability of the system that the system must meet to achieve the required standard, security, certification, or legal and contractual conditions. Furthermore, all requirements must be documented.

Different types of requirements information can be distinguished, such as [6]:

- Business requirement: A high-level business objective of the organization that builds a product or of a customer who procures it.

- Business rule: A policy, guideline, standard, or regulation that defines or constrains some aspect of the

business. Not a software requirement in itself, but the origin of several types of software requirements.

- Constraint: A restriction that is imposed on the choices available to the developer for the design and construction of a product.

- External interface requirement: A description of a connection between a software system and a user, another software system, or a hardware device.

- Feature: One or more logically related system capabilities that provide value to a user and are described by a set of functional requirements.

- Functional requirement: A description of behavior that a system will exhibit under specific conditions.

- Non-functional requirement: A description of a property or characteristic that a system must exhibit or a constraint that it must respect.

- Quality attribute: A kind of non-functional requirement that describes a service or performance characteristic of a product.

- System requirement: A top-level requirement for a product that contains multiple subsystems, which could be all software or software and hardware.

- User requirement: A goal or task that specific classes of users must be able to perform with a system, or the desired product attribute.

Software requirements include three distinct levels: business requirements, user requirements, and functional requirements. In addition, every system has an assortment of nonfunctional requirements. The model in Figure 1 illustrates a way to think about these diverse types of requirements [6].
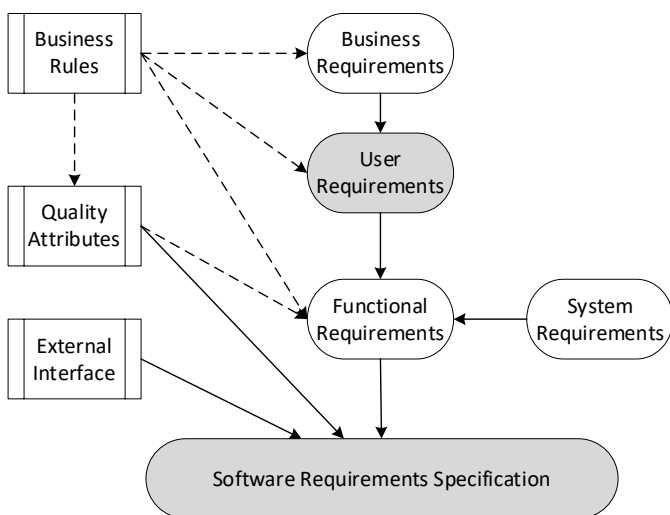

Figure 1. Relationships among several types of requirements information; source: own, prepared based on [6]

Identification of user requirements is the main concern of this text. The users' requirements should be essential for information system development. This is a basic assumption and there are recommendations for getting the users' requirements. However, the crucial questions are - Are the identified requirements really major?; Did the user identify really the essential requirements? Didn't the user forget about some important requirements? Thus, the relevance of the acquired user requirement set can be determined and checked?

Identification of requirements for the information system forms an important process in the development of the information system. The cooperation of the users of the emerging system in this process is necessary and crucial, and directly affects the quality and functionality of the system in terms of supporting the work of employees. The identification of requirements is generally considered to be one of the weakest points in the development of an information system. Methods and procedures for determining requirements are theoretically recommended and practically used, future users of the emerging information system are interested in cooperating in requirements identification, however, verification of the correctness of the requirements often only becomes apparent after the system has been completed, when users can verify whether the information system contains the essential requirements that they need to support them in carrying out their work activities. This is not a rare situation, which this situation occurs even though users are interested in working together to identify requirements.

It is necessary to take into account the situation that it is a special type of information system, respectively determined for a special type of user who is not interested in cooperating and even who tends to conceal functionalities. However, even here we need to get a complete set of system requirements. This type of system and users is described in Chapter IV. Therefore, our interest is divided into two sentences, firstly how to generally obtain a complete set of requirements, and secondly how to approach the analysis of special systems.

III.   USER REQUIREMENTS – VOICE OF USER

User requirements generally relate to a product, whether the product is a product or service or an information system. User requirements describe goals or tasks the users must be able to perform with the product/system that will provide value to someone [7]. The domain of user requirements also includes descriptions of product attributes or characteristics that are important to user satisfaction.

A. *Weaknesses in Identifying User Requirements*

User requirements characterize what the users need to do with the system from their working point of view. However, it is not possible to assume and rely on users to determine a comprehensive and correct set of information system requirements.

Typical situations when identifying and analyzing requirements are [6]:

- The project's business objectives, vision, and scope were never clearly defined.

- Users were too busy to spend time working with analysts or developers on the requirements.

- The team could not interact directly with representative users to understand their needs.

- Users claimed that all requirements were critical, so they didn't prioritize them.

- Developers encountered ambiguities and missing information when coding, so they had to guess.

- Communications between developers and stakeholders focused on user interface displays or features, not on what users needed to accomplish with the software.

- The users never approved the requirements, or the customers approved the requirements for a release or iteration and then changed them continually.

- The project scope increased as requirements changes were accepted, but the schedule slipped because no additional resources were provided and no functionality was removed.

- Requested requirements changes got lost; no one knew the status of a particular change request.

- Users requested certain functionality and developers built it, but no one ever uses it.

- At the end of the project, the specification was satisfied but the customer or the business objectives were not.

Ways to represent user requirements include use cases [8], user stories, and event-response tables [9] [10]. However, the information system is a product intended for its customer, i.e. for the user. Therefore, it is suitable to use support tools, as various business methods use the Voice of Customers modeling, i.e. in this case the Voice of Users modeling.

B. Methods for Voice of Customers Identification

The Voice of the customer can be obtained and identify in a variety of ways: interviews, surveys, customer specifications, observation, warranty data, field reports, etc. [11]. All business process methods recommend the use of support tools for identifying and describing the voice of the customer. These include such as Cause and effect diagram, Kano model, 5xWhy, Critical to Quality method, Flowchart, Mental map, etc. Key quality criteria are the measurable characteristics of a process or service from the customer's point of view. When using the Critical to Quality method, it transforms the voice of the customer into these critical characteristics. These characteristics are already applicable since they mostly define specific limits of the information system [12].

CTQ tree is a graphical tool for transforming a user's voice to critical values where user needs are gradually decomposed into individual measurable parameters (see Figure 2) [13]. Causes and Critical to Quality indicators are analyzed with the help of the Cause and Effect diagram, definition and effects have to capture the root cause.

The Kano model provides a useful method how to evaluate whether the set of requests is correct, complete, without mistakes. The requests can deal with a product or an information system. Traditional ideas about quality have often assumed that customer satisfaction was simply proportional to how functional the product or service was. This would mean that an information system with more fulfilled functionalities is more satisfying for users, and an information system with fewer implemented functionalities less satisfies users. But this is not true, because it depends on which functionalities are implemented and also which functionalities in the IT service are missing. The Kano Model offers a way of understanding and categorizing the types of Customer/Users Requirements (or potential features) for new products/information services [14]. Requirements are evaluated according to categories and this expresses their importance or, conversely, insignificance.
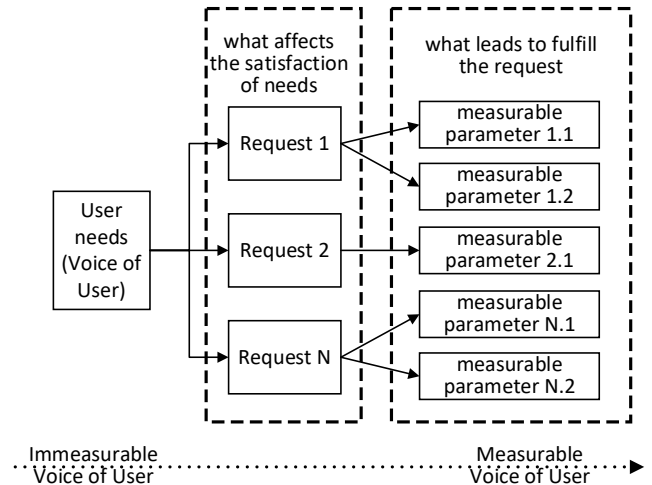

Figure 2.   CTQ tree; source: own

The Must-be (basic) requirements are the most important, the user considers them as a matter of course requirements, however, are usually not explicitly demanded by the user. The One-dimensional (standard) requirements are important, are usually explicitly demanded by the user. The Indifferent or Reversal requirements are useless and the user doesn't even need them. (see Figure 3).
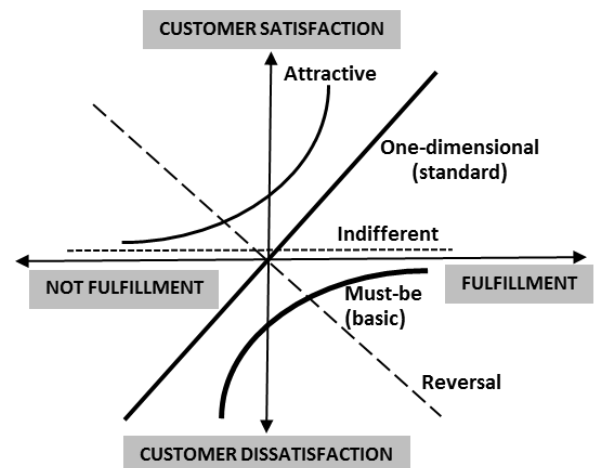

Figure 3.   Categorization of the requirements by the Kano model; source: own, prepared based on [15]

C. Evaluation of Identified Requirements

Evaluation of requirements, their prioritization, and finding out the significance of requirements is the content of other auxiliary methods, which include, for example, CRUD and MoSCoW methods. The MoSCoW method deals with the scheme of four possible priority classifications for the requirements in a set [16]. The Must-requirement must be satisfied for the solution to be considered a success. The Should-requirement is important and should be included in the solution if possible, but it's not mandatory to succeed. The Could-requirement represents a desirable capability, but it could be deferred or eliminated, in other words, it is implemented only if time and resources permit. The Won't-requirement indicates a requirement that will not be implemented at this time but could be included in a future release.

Finding missing requirements is an important next step in requirements analysis. Missing requirements constitute a common type of requirement defect. The following techniques can help detect previously undiscovered requirements [6]:

- Decompose high-level requirements into enough detail to reveal exactly what is being requested.

- Ensure that all user groups have provided input.

- Trace system requirements, user requirements, event-response lists, and business rules to their corresponding functional requirements to make sure that all the necessary functionality was derived.

- Check boundary values for missing requirements.

- Represent requirements information in more than one way.

- Create a checklist of common functional areas to consider for your projects.

- A data model can reveal missing functionality.

The previous section defined a general approach to obtaining and evaluating user requirements. It is assumed that the user defines his requirements for the system with the intention that he is interested in providing as many requirements as possible and as well characterized as possible. Support tools and methods then help to verify the properties of the requirements, i.e. correctness, completeness, feasibility, necessity, unambiguity, verifiability, etc.

IV. SPECIALIZED INFORMATION SYSTEMS OF PUBLIC ADMINISTRATION – RESTRICTIONS TARGETED SYSTEM

The situation is different or more complicated with specialized information systems in public administration.

Public administration manages and regulates the social system through its performance, both by creating support, creating legal norms, or by exercising control (collecting information). The control requires the existence of a controlled system and a control system that controls the function of the controlled system. Control and regulation of the system are possible only if the correct transfer of information between the elements of the system. A similar way of driving appears in the work environment [17].

Public administration, with the support of information systems, carries out controls and appropriate countermeasures (restrictions). As part of the performance of public administration with the use of the information system, a situation may arise in which a defensive function, such as lying or concealment, follows when social norms are violated or when any harmful situation arises [18].

Generally speaking, people consciously and unconsciously avoid management and restrictions because they do not want to be controlled. During control, it is necessary to ensure the acquisition of information about the actual state between the controlled and control element. If an information system is to be created for management and restriction, it is necessary to assume the reluctance of users to cooperate and the reluctance to pass on all information necessary for the further development of the system during the design and especially the management of system requirements (see Figure 4).

Especially in the phase of analysis and collection of requirements for this information, testing of requirements must be performed.
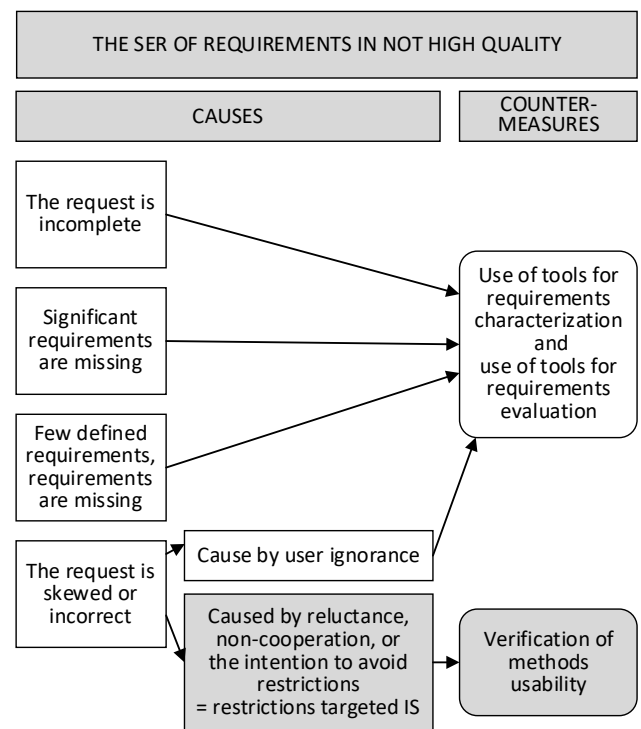

Figure 4. Causes of insufficient identification of requirements and countermeasures; source: own

A. The restrictions targeted information system - requirements collection

When creating a restriction targeted information system, one of the sources can be reports of misdemeanors and criminal offenses, which are registered by individual public

administration organizations. An evaluation of the number of such violations of legal regulations against the target group can determine appropriate activities and processes in public administration in which the new system solution will bring the greatest benefit.

As another source of requirements, it is possible to contact professional organizations or trade unions to protect workers in the field of interest. These organizations have knowledge and understanding of the activities in which the supervisory activities of public administration organizations are carried out [19].

Probably the most demanding in terms of time and cost are personal interviews with all interested participants in the project and the subsequent system, further group interviews, facilitation workshops, and the use of group creativity or questionnaires and surveys. If the project modifies an existing information system, it is possible to use observation of current processes or the record of reported problems from technical support [20].

When collecting requests within personal interviews, it is a matter of extracting as much information as possible relative to the future information system. The subject of interest is a specific information system, i.e. restriction targeted, the users of the system at the same time will be the subject to a restriction, therefore their primary interest is not to cooperate in the collection of requirements, or they directly want to avoid this restriction. The method of questioning must be in the form of a structured interview, such as interrogation in forensics.

The interrogation serves to establish the facts of the case without there being reasonable doubts about the established situation. A dialogue is conducted to identify erroneous information and to remind of missing facts. In case a different statement is found for more persons/users, it is possible to use a confrontation of these persons with each other during the interrogation [21].

Setting the main requirements for the system is possible to achieve using the Cause and effect diagram (see Figure 5), which shows the causes and consequences and aims to find the most likely cause of the problem.
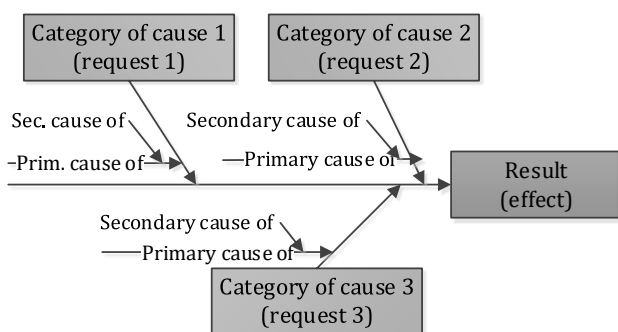

Figure 5.   Causes of insufficient identification of requirements and countermeasures; source: own

B. The restrictions targeted information system - requirements verification

Requirements verification focuses on ensuring the properties of a set of requirements, such as completeness, accuracy, feasibility, necessity, unambiguity, and verifiability [22]. For these restriction targeted systems, considerable interest is focused on the completeness, respectively, incompleteness because:

- users of these types of systems will not be interested or willing to provide certain facts,

- most requirements are written in natural language, which does not have a fixed form to prevent incompleteness.

Requirements expressed by natural language sentences can be analyzed using the following phases:

- Syntactic analysis: nouns and verbs are distinguished in the sentences, which are further worked on in identifying classes and their relationships as follows - nouns forming the subject are identified as classes or attributes, verbs are identified as relationships between classes. The main purpose is to identify classes, their attributes, and relationships, respectively identification of classes without attributes, which means the request was incomplete (see Figure 6).
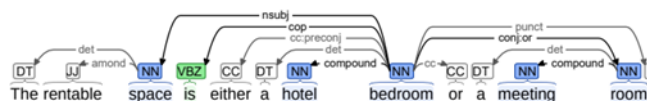

Figure 6.   Example of word mapping in requests; source [23]

- UML class diagram is created, which shows the found objects in the sentences as separate classes. Attributes from the found attributes are assigned to individual classes, relationships among classes are created based on verbs and identified objects.

- Subsequently, it is possible to analyze the incompleteness by checking the created class diagram. The classes are checked whether the class has at least one attribute and whether each class has at least one link to another class.

The requirements are checked to the correctness, resp. error detection. The following methods can be used:

- Creation of Checklists: for each type of request (functional, non-functional, user, and business) a list of common errors is written. During the check, all requests are scanned and errors are searched according to the list. Checklists are created mainly within one organization and are updated over time with the current and most common errors.

- Requirements inspection: it is a process that looks for errors. Participants in the inspection consist of the authors of the requirements documentation, people who will create a system based on the identified requirements, and also people who will be responsible

for the outputs of the inspection and managing versions of requirements during changes. The inspection consists of several meetings, where all requirements are gradually reviewed. Requests are recited by one of the participants, and inspectors look for errors that are written down immediately. Some errors can be corrected immediately, but for some solutions, it will be necessary to contact some stakeholders again.

The procedure is planned to be used in the design of a specialized tool, namely a system for performing inspections of obligations for spirits and for mapping the distribution of spirits. The system is to be used to restrict persons handling alcohol, as well as to restrict control staff who will be the main users and will use the system for their activities.

V. CONCLUSION

Identification of requirements for the information system, their collection, and analysis, all form an important process in the development of the information system. The cooperation of the users of the emerging system in this process is necessary and crucial, and directly affects the quality and functionality of the system in terms of supporting the work of employees. The identification of requirements is generally considered to be one of the weakest points in the development of an information system. Methods and procedures for determining requirements are theoretically recommended and practically used, future users of the emerging information system are interested in cooperating in requirements identification, however, verification of the correctness of the requirements often only becomes apparent after the system has been completed, when users can verify whether the information system contains the really essential requirements that they need to support them in carrying out their work activities. This is not a rare situation, but again let us remind this situation occurs even though users are interested in working together to identify requirements.

The situation is more complicated with special information systems, where users may have reasons not to cooperate. More precisely, these are systems where there are two types of users, the state (checking person) and the checked person. These are the information systems applying the control obligation of the state, i.e. they are, for example, intended to restrict persons and at the same time to restrict control staff. In this text, they have been referred to like the restrictions targeted systems. Users of the developed system will be subject to restriction, so it is not their primary interest to cooperate in the comprehensive identification of requirements, or they are directly trying to avoid restriction. Again let us remind that a discrepancy in requirements may occur even if users are interested in cooperating in identifying the requirements. In this case, the main focus is on helping users to identify complete requirements. Here, the situation is complicated by the fact that the information system under construction is to serve two types of users, on the one hand, the state, on the other hand, the checked/restricted person. The second type of user is not interested in cooperating or it is even possible to encounter intentional concealment of facts. Therefore, this process is complex and requires the application of identification methods and procedures from other fields, so that the result is a complete list of the correct requirements for the planned information system.

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