

## Perception and Enterprise Communication Networks to Improve the Requirements Elicitation Process

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**Abstract.** The requirements elicitation phase of software development projects is characterised by the intensity and importance of communication activities. Requirements elicitation is a traditional exploratory phase in which context is analysed and an abstraction is performed as a consequence. However, exploratory processes are characterised by a deep interaction with environmental factors. In this paper, we present a process for managing communication during the requirements elicitation phase. Our process would help get well-defined requirements by using knowledge inside organisations and a classification of requirements perception based on how environment is controlled by stakeholders. Our approach can be used to guide the elicitation process as well as to validate the requirements.

### 1. Introduction

In spite of the highly technical and formal nature of software, creating it remains a very people-intensive activity. It is well known that users should be involved in a requirements elicitation process, however, there are few advances in this particular area, since the process still depends on the skills and experience of the system analyst who is eliciting the requirements. Unfortunately, deficient requirements are the single biggest cause of software project failure [1]. Stakeholder dialog is a pillar of the requirements elicitation process. Typically, the analyst converses with the customers about their needs. In turn, the analyst may raise questions about the requirements, which lead to further conversations. Like many dialogs, requirements elicitation can be difficult to manage [2]. It is widely recognised that communication problems are a major factor of software projects. The organisational domains into which such software is introduced are often too intricate to be fully understood. Hence requirements descriptions are necessarily uncertain [3].

From our empirical studies on auditing quality management standards in enterprises, which are trying to adapt or implement a quality management system, we have built a set of heuristics and strategies for improving the requirements elicitation process. Principles, such as *transparent communication* [4], have been used to detect how to gather information and how to define requirements in such a way that feedback and user's support are always encouraged.

We know that most RE activities are exploratory. RE engineers acquire and discover requirements and knowledge about the problem domain by conducting an information search. Exploratory activities are characterised by a deep interaction between stakeholders and the environment, which is always abstracted and interpreted. Environment affects stakeholders before and after receiving behaviour as a response of a stimulus. Environment conditions, behaviour itself, and consequences are interrelated in such a way that a stimulus detected in the environment acquires certain control on answers. In this case, stimulus does not trigger an answer as a reflex behaviour. Simply, the occurrence of an answer is more probable, and even more, it can occur combined with other conditions that affect its probability. It is common that an answer reinforced in a given situation occurs in a similar situation due to a generalisation process. However, if the answer is reinforced

only when a particular property is present, it acquires an exclusive control by a process called *discrimination* [5]. Our strategy also present a classification of stakeholders' perception of requirements based on controlling environmental behaviour, which can be used for detecting incomplete and conflicting requirements.

## 2 A Strategy for Improving the Elicitation Process

Knowledge is extracted from information transported by a signal (oral language, gesture language, etc.) through a channel. In spite of different types of organisations exist, the following enterprise communication networks, which are the support of all information, can be found:

- *Hierarchical Network*: a formal organisation that is represented as a hierarchy connecting managers to subordinates – a diagram known as flow-chart. In general, this network is not effective to allow information flows.
- *Informational Network*: information related to organisation's functions. This view describes relationships among the information used by the enterprise. It includes all information forms and notes how their placement and distribution support users and applications.
- *Expert Network*: information needed to accomplish a task. It includes how a particular task should be done as well as how some problems should be solved. The main pitfall of this kind of network is that, sometimes, specialised information exists, but experts don't become aware of the methods needed to get it. To deal with this situation, a new information network can be produced as a consequence. Expert networks can be composed of manuals, specific procedures, and of course, experts.

Enterprise communication networks constitute the formal and informal structure on which enterprise communication flows. Strictly speaking, an enterprise has its own formal communication channels that are called *communicating flows* or *vectors* used to transmit messages throughout the organisation [4]. Regarding to the hierarchical and informational networks, we should first analyse communicating flows inside the organisation. They can be (1) *upward and downward*: these flows allow that communication through the hierarchical network occurs, and they are used as a command-reporting channel; (2) *horizontal*: these flows allow that communication among employees on the same hierarchical level occurs, and they are used for accomplishing routine teamwork; and (3) *transversal*: these flows allow that communication among employees in different areas that are not connected through the hierarchical network occurs.

In our empirical studies on several enterprises in different realms (Clinics, Newspapers, China producers, Hydroelectric enterprises) a sample of tasks that involves more than one area of each organisation was used to detect communicating flows or vectors, and to determine their predominant direction – upward/downward, horizontal, or transversal. After that, a strategy was defined to conduct the requirements elicitation process [6][7]. As a first heuristic, we found that *when predominant vectors are horizontal and upward/downward, starting elicitation through organisation's areas is more convenient. On the other hand, when transversal vectors are significant, starting elicitation through organisation's processes is easier.*

Depending on our behaviour and the executive director's decisions, our arrival is always a cause of uncertainty in an organisation. Uncertainty generates entropy, in such a way that the greater uncertainty our presence generates the greater is the entropy. As a consequence, a considerable

amount of gathered information is useless because users are unwilling to share their domain knowledge. Therefore, as a second heuristic, *we should try to minimise entropy by using a strategy that considers every kind of communicating flow inside the organisation.*

Our strategy is based on three pillars: reducing uncertainty generated by changes, detecting enterprise communication networks to know where requirements should be elicited, and detecting the communication flows or vectors that flow inside the networks to know how to proceed in the elicitation process. This strategy can be used along with many other techniques. For example, contextual-inquiry technique uses five models in which, after an appropriate number of site visits, the requirements team interprets the data and compiles a user profile that represents the common traits of all the users observed and interviewed [8]. Analysing requirements could perfectly be done by “guiding” the interviewing process using enterprise networks.

Two kinds of products are generated when our strategy is applied: (1) a diagram of each enterprise network written in UML notation for deployment diagrams [9], and (2) bi-dimensional tables representing the communicating flows and also comments and “fears” of our users.

The following strategy’s activities are usually applied without a specific order. It was introduced here as a way of clarifying the concepts.

1. *Detect Enterprise Communication Networks*: Selecting appropriate people is a fundamental activity to achieve a successful elicitation process. Specifically, the way of approaching a selection depends on the communication network (hierarchical, informational, or expert) that we want to model. Knowledge depends on previous exposition to reinforced contingency conditions, but we also acquire a special kind of knowledge when we are capable of proclaim rules or laws. That is, a person can “know” how to use an instrument because he or she has read the instructions, even though he or she has never used it. Knowledge that allows people to describe contingencies is very different from knowledge identified with the behaviour produced by contingencies. Decomposing contextual perceptions into its constituting parts can help define more precise and traceable software requirements specifications. To do that, some activities should be taken into account. First of all, every element of a contextual perception (CP) should be clearly stated and documented. Several techniques for documenting data, processes, and constraints exist, so we omit the details here for brevity. According to our approach, elements of a CP are analysed from different perspectives (provided by stakeholders) and they are also influenced by the role played by stakeholders. So, we have more than one view of the same reality and we need to conciliate these different views. We propose using a contextual perception matrix as a documentation of all perceptions made on the same reality (one matrix’s row). Every element of the matrix is a reference to the documents that collect all the information (data, processes, and constraints) supplied by a particular stakeholder. Of course, the information is strongly influenced by the role played by the stakeholder. It should be validated taking into account the actual source of the information (an expert, a naïve user, etc.). Perception of different realities can be documented in the same way, and hence new rows are added to the matrix [10].
2. *Use Communication Flows*: As we previously mentioned, we should analyse every area of an organisation to detect how messages flow through the networks in order to accomplish different works. Identifying the direction of the vectors is the main goal when we are detecting them. Focusing on vectors underlines the importance of a multi-directional communication. Therefore, a horizontal vector among peers could facilitate the interchange of information among areas, increase internal cohesion, facilitate management processes, and encourage communication. An

upward vector could help improve the social dialog in the enterprise stimulating consensus and supporting a participative system. A downward vector ensures that every member of a process or sector knows and understands the goals and objectives of the organisation. Interpersonal communication is also improved. Finally, a transversal vector could help define a common language among all stakeholders and select activities according to the organisation's principles.

3. *Manage Uncertainty*: Researchers have developed requirements negotiation models, however little attention is given to the socio-psychological aspects of the process [11] even though, achieving a high quality communication reduces uncertainty [12]. High quality communication starts establishing "harmony" among stakeholders, where harmony is defined as "compatibility" or "affinity". People who get harmony among each other are comfortable working together, they are open mind and they are honest in their communications. Of course, this is a desirable situation when we are eliciting requirements. The challenge is to keep a harmonic state between stakeholders during enough time. Users' doubts concerning the elicitation process itself and/or its consequences are part of the information we should obtain. This knowledge would be useful to get commitment and trust on people collaborating to define requirements.

### Conclusions and Future Work

We have presented a strategy for eliciting requirements based on detecting and defining the elements that compose traditional enterprise communication networks. These networks are present in every sort of organisation and constitute a basement on which requirements analysis decisions can be built. As a consequence, uncertainty is reduced and selecting experts is more appropriate. However, in spite of the strategy has been applied in several cases, its impact on the elicitation process has only been informally recorded. In the next stage of our work, we are extending the strategy to include some features to be measured as well as a measurement procedure, in order to provide an objective evaluation. Several on-going experiments based on the GQM (Goal/Quality/Metric) approach [13] will quantify the impact of our strategy on traditional software development projects.

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