FACING MOVING TARGETS?

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Abstract – It is widely acknowledged that requirements change during systems development projects. The reasons are usually explained by changes in lower-level goals, while high-level goals are expected to be stable. In this paper we analyse, and compare, how two electronic government projects use goals as a basis for procuring new Information Technology systems. The high-level goals of these projects have evolved differently, where high-level goals changed in one project, but remained stable in the second project. This can be explained by the fact that the two cases have interpreted the concept of high-level goals differently. We believe that goal-stability increases when values are related to high-level goals during goal-oriented requirements engineering. This illustrates the importance of taking political values into consideration when defining the high-level goals for electronic government projects.

1. Introduction

Information Technology (IT) is, for most people, an intangible ‘something’, difficult to visualize and with effects almost impossible to predict and take in. This makes development or purchase of IT-systems, for most organizations, an uncertain adventure. It is almost impossible, if we have little or no experience of IT-systems, to exactly understand how a new IT-system will be used. It is not until we have the actual IT-system in front of us, that most people can establish visions about future use. Hence, the eliciting of requirements is difficult, and a number of studies show that IT-systems fail [e.g. 1, 2, 3] due to short falls in requirements engineering (RE). Systems development has moved away from assumptions that systems requirements are stable and given. Today, it is widely recognized that requirements change [e.g. 4, 5] and that they are constructed [6] through negotiation by the systems development project actors.

Goals have been introduced as a way to separate volatile and stable requirements. The causes of requirements change are often explained by the lower-level goals, while the high-level goals – goals of strategic nature [7] – are assumed to be stable [8]. Goals are understood as declarative statements that an IT-system has to meet [9]. In the area of goal-oriented RE goals can be structured as hierarchies [8], where goals are divided into sub-goals. In other words high-level goals are operationalized by lower-level ones. The purpose of this paper is to show how two similar electronic government (eGov) IT projects, where goals have been explicitly used during RE, interpret the concept of high-level goals differently, resulting in different goal stability.

The paper proceeds as follows. In the next section, we recapture related research on goal-oriented RE in the RE and eGov fields. This is followed by the adopted research approach in
Section 3. Section 4 covers the reconstruction of the two case studies, and how they have used goals during the systems development projects. The paper ends with a concluding discussion in Section 5, pointing out implications for practice and research.

2. Related research

2.1 Goal-based requirements engineering

Goals have long been acknowledged as important in RE [4, 7, 10-13], and the concept has lead to a wide set of tools to support ‘requirements elicitation, elaboration, verification, validation, explanation and negotiation’ [8]. Van Lamsweerde [8] states several reasons why goal-based modelling is important in the RE process. Two of these reasons concern our study: (1) low-level technical requirements can be derived from high-level goals and (2) goals provide the possibility to separate stable and volatile requirement information. Observations [8, 14] have been made that high-level goals are stable with respect to requirements. According to Hoorn et al. [7] ‘requirements change should be sought in a change of lower level goals.’

The current state of the art in goal modelling reveals different types of goals and goals structures [14, 15]. For example, a distinction is made between hard versus soft goals, where the latter are not possible to quantitatively measure [16]. As mentioned in the Introduction, another classification is the division between high-level and low-level goals [7]. In addition goals are sorted into structures based on the use of links. Different types of links can be found ‘to relate goals (a) within each other and (b) with other elements of requirements models.’ [8] The first type of links capture if and how goals support or contradict each other, e.g., refinement links [17], which can be used to illustrate under which conditions a superior goal is satisfied. The second type of links illustrate associations to other requirement artefacts that are derived from the modelled goals, such as, use case models [18]. Together the different taxonomies and types of links constitute the basis for different types of goal structures, such as networks and hierarchies.

2.2 Requirements engineering in electronic government

In the intersection between RE and eGov much attention has been devoted to requirements of various types of eGov architectures. Dias and Rafael [19] discuss the requirements for realizing one-stop eGov. Other examples of similar requirements research is Wimmer [20], Steimke & Hangen [21] and Medjahed [22]. These studies focus, however, on the requirements and not on the requirements process as such. Donzelli and Brasciani [23] provide, what they term, a framework for goal-oriented RE. They report on how this framework is used in an eGov project. In addition, they compare this framework with existing frameworks for goal-oriented RE and conclude that this simplified framework ‘greatly enhances stakeholders’ acceptance and understanding.’ However, they do not address the stability of high-level goals during eGov projects.

3. Adopted research method

Considering the nature of the research question this study is classified as interpretive [24, 25]. The two cases, DocIT and Sofia Omfale, are reconstructions of two systems development processes of purchasing and adapting a standardized IT-systems for administration of elderly
care. As the study’s focus is goal stability, we need to compare how goals change over time. In order to do that we compare the initial requirement goals, expressed by actors in the local governments, with the final ones. Hence, we are able to observe whether high-level goals have changed during the course of the projects. We have separated data-collection from analysing goals. The researcher who was involved in data-collection, has not carried out the goal-analysis, which was important as a way to minimize bias.

### 3.1 Case settings

The first case study, Sofia Omfale, was a reconstruction of an IT-system already in use. The main reason for purchasing Sofia Omfale was that the current administrative routines were deemed unsatisfactory. A new IT-system was seen as a way to solve problems of following-up on finances and the work carried out. We had access to rich documentation describing the RE process. All in all the documentation covers four years. The empirical material on initial goals includes the requirements specification, decision documents, information about the IT project, project plan, and project reports. The final goals are based on the following documents: decision document, information about the IT-system, and evaluation report [26]. We also include interviews with system owner, project leader, and systems manager as a complement to the evaluation report.

During the second case, DocIT, we were able to follow how the idea of a new IT-system was materialized into an implemented and used product. One of the main reasons for procuring a new IT-system was a need for a mutual system used by everyone working in elderly care. This would hopefully increase cooperation between the staff and improve the quality of elderly care. We took part in the project meetings where the requirements decisions were made. The project documentation covers the complete two year development process. The empirical data on initial goals is based on the requirements specification and decision documents. The final goals were analysed by interviewing users, politicians, the system owner and the chairman of the steering committee.

### 3.3 Data analysis

For each project we reconstructed goal graphs using a unified notation, inspired by Yu [13]. Although both projects have been working with goal-oriented RE they have not been using goal graphs in a structured way. Consequently, the purpose was to make the projects more comparable. We have selected goals put forward as important by the user-organizations in documents and during interviews. Both projects consist of a large number of goals ranging from high-level goals to more low-level goals. For the sake of simplicity in the presentation we focus on the top hierarchy of the reconstructed goal graphs, meaning that we present the high-level goals of each eGov project from two different observation points in terms of time, with a selection of supporting sub-goals. Furthermore, due to space limitations we have chosen to present the analysis using graph theory notation. For example, if we have three goals, X, Y and Z, where X is supportive to Y, and Y is supportive to Z, the structure will be presented as \( E = \{\{X,Y\},\{Y,Z\}\} \).

The high-level goals are the top nodes in each goal graph. We have used the organizations’ definition and naming of high-level goals and supporting sub-goals. Hence, what is considered as high-level goals in the analysis depends on what the organizations have expressed as the ultimate project goals.
4. Reconstruction

4.1 Sofia Omfale - Reconstruction of initial requirement goals

We have identified four goals that constitute the high-level goals for Sofia Omfale. The first high-level goal, SO1.1, concerns ‘efficient use of resources.’ The organization wants to minimize the cumbersome administration. Two direct prerequisites for ‘efficient use of resources’ was, according to the requirements specification, ‘efficient administration’ (SO1.6) and ‘enable economic forecasts’ (SO1.5). In turn these goals are anchored in ‘facilitate follow-ups’ (SO1.7) and ‘unified information about real circumstances’ (SO1.8). Appropriate follow-ups make it possible to create an efficient administration and are viewed as a starting point for forecasting. This goal is anchored in SO1.9 ‘coherent information about the client’ and SO1.10 ‘guarantee satisfactory routines.’ Furthermore, behind goal SO1.8 we find goal SO1.11, ‘replace manual forms’ with standardized IT implementations. Through the use of standardized forms it is possible to create uniform information. We can summarize this sub part of the graph as \( E = \{\{SO1.11,SO1.10\},\{SO1.11,SO1.8\},\{SO1.10,SO1.9\},\{SO1.9, SO1.7\},\{SO1.7,SO1.6\},\{SO1.6,SO1.1\},\{SO1.7,SO1.5\},\{SO1.8,SO1.5\},\{SO1.5,SO1.1\}\}.

The second high-level goal is ‘enable debit items’ (SO1.2). Behind this goal we find possibilities to debit clients for received care on the basis of information provided by the care personnel. According to the basic data for decision-making this requires ‘coherent information about the client’ (SO1.9). In turn, goal SO1.9 is achieved through satisfactory routines, goal SO1.10, ‘guarantee satisfactory routines’. Finally, ‘replace manual forms’ (SO1.11), is a supportive goal for satisfactory routines. Hence the sub graph for SO1.2 is \( E = \{\{SO1.11,SO1.10\},\{SO1.10,SO1.9\},\{SO1.9,SO1.2\}\}.

The third high-level goal (SO1.3) was ‘quality assurance’ with a focus to ensure good information quality for debiting and evaluation. In order to fulfill this goal we have identified the following sub-goals: ‘coherent information about the client’ (SO1.9), ‘guarantee satisfactory routines’ (SO1.10), and ‘replace manual forms’ (SO1.11). The sub graph for SO1.3 is summarized as \( E = \{\{SO1.11,SO1.10\},\{SO1.10,SO1.9\},\{SO1.9,SO1.3\}\}. Hence, the second and third high-level goals share the same refinement.

Finally, the fourth high-level goal (SO1.4) is ‘congruence between the IT-system and the organisation.’ The organisation was working with process orientation, but the existing IT-system did not support that way of working. This is evident from the goal SO1.12: ‘a process oriented IT-system.’ In addition to this goal it was important to provide the organisation with an ‘integrated IT-system’ (SO1.13). It means that the system shall be linked to other IT-systems and that information shall be provided by actors in the care processes. Summarizing the sub graph of SO1.4 gives \( E = \{\{SO1.12,SO1.4\},\{SO1.13,SO1.4\}\}.

4.2 Sofia Omfale - Reconstruction of final requirement goals

This section presents the reconstruction of the final goals from the Sofia Omfale project. The presentation provides a comparison to the initial goals of the project, and depicts how the goals have evolved between these two points in time. Starting with the high-level goals in Section 4.1 we find that two high-level goals have remained stable during the project. The first goal is ‘enable debit items’ (SO2.3) that corresponds to SO1.2. It is supported by both SO2.7 ‘coherent information about client’ and SO2.10 ‘increase security’. Both these goals are supported by SO2.8 ‘guarantee satisfactory routines’, which finally is anchored in SO2.9 ‘replace manual forms’. Hence, the sub structure of SO2.3 is \( E = \{\{SO2.9,SO2.8\},\{SO2.8, \)
SO2.7}, {SO2.7, SO2.3}, {SO2.8, SO2.10}, {SO2.10, SO2.3}. Goal SO 2.10 corresponds to the high-level goal SO1.3 ‘quality assurance’; it still concerns information quality but with a different wording. More important, is the fact that this goal is now viewed as a sub-goal to enable debiting. Hence, while still a goal it is not among the high-level goals.

The second stable high-level goal ‘congruence between the IT-system and the organisation’ (SO2.4) corresponds to the high-level goal SO1.4 in Section 4.1. However, the sub-goal structure has changed during the project. During the initial requirements attention was given to an ‘integrated IT-system’ (SO1.13) and that the new IT-system had to support a process oriented way of working (SO1.12). These goals can no longer be found in the project, while the importance to ‘ease maintenance’ (SO2.11) and ‘to solve the year 2000 problem’ (SO2.12) are emphasized. The latter was not discussed during the initial goals, while the former is found but with a lower priority. Summarized as a sub structure we find E = {{SO2.11, SO4}, {SO2.12, SO2.4}}.

Two new high-level goals have appeared in the final set of goals: ‘unified communication’ (goal SO 2.1) and ‘support care planning’ (SO 2.2). The SO2.1 is supported by ‘unified information about real circumstances’ (SO2.5) and ‘guarantee satisfactory routines’ (SO2.8), which in turn is supported by ‘replace manual forms’ (SO2.9). Summarizing the support for this high-level goal we have E = {{SO2.9, SO2.5}, {SO2.5, SO2.1} {SO2.9, SO2.8}, {SO2.8, SO2.1}}. The high-level goal SO2.1 was to some extent present in the initial goal hierarchy, but as supporting goal to ‘efficient use of resources’ (SO1.1). Hence, the unified communication goal has been emphasized while the efficiency goal has disappeared together with the goal ‘efficient administration’ (SO1.6).

The second new high-level goal concerns the use of the information for planning (SO2.2): ‘support care planning.’ This goal was not to be found at all during the initial requirements. Hence, it has emerged as an opportunity on how to use the information in the IT-system. The goal is supported by SO2.6 ‘facilitate follow-ups’, which in turn builds on ‘coherent information about the client’ (SO2.7). Furthermore SO2.7 is supported by ‘guarantee satisfactory routines’ (SO2.8) and ‘replace of manual forms’ (SO2.9). These goals are found in the initial goal hierarchy as well, but associated with the high-level goal ‘efficient use of resources’ (SO 1.1) which now has disappeared. The new goal structure can be summarized as E = {{SO2.9, SO2.8}, {SO2.8, SO2.7}, {SO2.7, SO2.6}, {SO2.6, SO2.2}}.

4.3 DocIT - Reconstruction of initial requirement goals

In this section we present the reconstruction of the initial goals from the DocIT project. We have identified five high-level goals: ‘proper care’ (D1.1), ‘low cost’ (D1.2), ‘equal care’ (D1.3), ‘confident care personnel’ (D1.4) and ‘safe care’ (D1.5).

The first of the high-level goals we have identified is to provide ‘proper care’ (goal D 1.1). Proper care means that the client receives the carte he or she needs. This goal is supported by the following goals: ‘good information for planning’ (D1.6) and ‘reallocation of resources’ (D1.7). D1.6 focuses the prerequisites to provide proper care. Goal D1.7 has a chain of supportive goals: ‘efficient care’ (D1.8), ‘efficient administration’ (D1.9) and ‘make follow-up possible’ (D1.10). Furthermore, goal D 1.6 is a basic condition for goal D 1.10, ‘make follow-ups possible.’ Both these goals are anchored in D1.15 ‘unified, secure, and sufficient information’ and D1.16 ‘shared and easy accessible information.’ The described goals constitute the following sub structure E = {{D1.16, D1.15}, {D1.15, D1.6}, {D1.15, D1.10}}.
The second high-level goal that we identified is ‘low cost’ (D1.2) – to spend the tax payers’ money wisely. Hence, this goal is superior to ‘efficient care’ and ‘efficient administration’, goals D1.8 and D1.9. In addition, goal D1.9 is anchored in the substructure described in the previous paragraph, involving D1.10, D1.6, D1.15 and D1.16. In summary this substructure is defined as \( E = \{\{\{D1.16,D1.15\},\{D1.15,D1.6\},\{D1.15,D1.10\},\{D1.6,D1.10\},\{D1.10,D1.9\},\{D1.10,D1.8\},\{D1.9,D1.2\},\{D1.8,D1.2\}\} \).

The third high-level goal, ‘equal care’ (D1.3), means that a client has the right to equal care. This goal is achieved through goal D 1.11, ‘quality assurance.’ Quality assurance is supported by its two sub-goals, ‘make follow-ups possible’ (D1.10) and ‘shared templates and procedures’ (D 1.12). Shared temples and procedures are facilitated by the goal to reach ‘unified, secure and sufficient information’ (D1.15) together with ‘shared and easy accessible information’ (D1.16). We end up with the following substructure \( E = \{\{D1.16,D1.15\},\{D1.15,D1.6\},\{D1.15,D1.12\},\{D1.12,D1.11\},\{D1.11,D1.3\},\{D1.15,D1.10\},\{D1.10,D1.11\}\} \).

The fourth high-level goal, D1.4, we have identified is ‘confident care personnel.’ This goal concerns the well being of the care personnel, and is supported by ‘legitimize work’ (D1.13). Furthermore, ‘unified, secure and sufficient information’ (D1.15) and ‘shared and easy accessible information’ (D1.16) provide the base for legitimizing the work. Hence, the substructure is defined as follows \( E = \{\{D1.16,D1.15\},\{D1.15,D1.13\},\{D1.13,D1.4\}\} \).

Finally, we have the fifth high-level goal, D1.5, for DocIT: ‘safe care.’ The client and his/her relatives shall be able to rely on the care and information they receive. According to the basic data for decision-making this goal is achieved through ‘following rules and regulations’ (D1.14). Furthermore, D1.5 is also anchored in ‘unified, secure, and sufficient information’ (D1.15) and ‘shared and easy accessible information’ (D1.16). This provides us with the following substructure \( E = \{\{D1.16,D1.15\},\{D1.15,D1.5\},\{D1.14,D1.5\}\} \).

### 4.4 DocIT - Reconstruction of initial requirement goals

The reconstruction of the final high-level goals for the DocIT project is very similar to the structures presented in Section 4.3, because the five high-level goals have remained stable during the project. We have only identified two changes, which are found in the substructures of the high-level goals.

First, we have a new goal directly associated to the high-level goal ‘confident care personnel’ (D2.4). This goal, ‘equal access to information’ (D2.17), concerns how information is accessed and by whom. Employees sharing the same role shall have the same access to information. Consequently, it strengthens the care personal as a working group. Hence, we have inserted the new goal in the existing substructure of goals, ‘legitimatize work’ (D2.13), ‘unified, secure, and sufficient information’ (D2.15) and ‘compatible with other IT-systems’ (D2.16). We end up with \( E = \{\{D2.16,D2.15\},\{D2.15,D2.12\},\{D2.13,D2.4\},\{D2.17,D2.4\}\} \).

Second, we find that the goal D1.16, ‘shared and easy accessible information’ has received a different interpretation. This is evident when studying further sub-goals in this branch (not presented in this study), and the new wording ‘compatible with other IT-systems’ (D2.16).
More focus is, for example, put on compatibility issues and integration with other systems. Hence, this part of the goal structure has become more complex.

5 Concluding discussion

The purpose of this paper is to show how two similar electronic government projects, where goals have been explicitly used during requirements engineering, interpret high-level goals differently, resulting in different goal stability. The illustration is done by drawing on examples from two case studies within elderly care, Sofia Omfale and DocIT. Both cases concerned implementation of similar IT-systems within the same problem domain. Two sets of goals have been compared for each case. The first set is a reconstruction from the first official version of the requirements specification, and the second set is a reconstruction of the last version of the requirements.

The high-level goals of the two projects have evolved differently. In the case of Sofia Omfale we find significant changes among the high-level goals between the two observation points. Even two of four high-level goals in the goal hierarchy had been exchanged. The DocIT case proves to be the opposite pole. Only small changes can be identified, and the high-level goals have remained stable between the observation points. This can be explained by the fact that the two cases have used, and interpreted, high-level goals differently. For Sofia Omfale, the main purposes of the new IT-system were to e.g., improve routines for debiting, and contribute to congruence between the new IT-system and the organisation. Consequently, the project was seen as a solution to problems with routines and inefficient administration. DocIT, on the other hand, related its high-level goals to political and organizational values. Two examples are equality and safety that resulted in high-level goals such as equal care and safe care. This difference of basing the high-level goals of the IT projects on different rationalities, can explain why the high-level goals are stable in the case of DocIT, while they change in the case of Sofia Omfale.

The results illustrate the importance of taking political and organizational values into consideration in electronic government IT projects. By relating values to high-level goals during goal-oriented requirements engineering goal stability will increase. Furthermore, it should be acknowledged that the interpretive nature of this research might have induced researcher bias. Hence, it calls for more comprehensive future research.

References


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