Developing User Requirements for Trans-national Government Information Systems

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Abstract
This paper presents our participant-performer case-based experience in eliciting user requirements for the development of a pan-European, trans-national government information system (TN-GIS). It is widely recognized that a significant challenge for Information Systems (IS) developers is the creation of systems specifications that align with user requirements. Many IS failures have been attributed to the mismatch between user requirements and what is actually produced. Specifying Information Systems (IS) through user requirements elicitation has always been challenging. In this paper we focus on Trans-national Government Information Systems which have their own ‘special complications’. Our findings to date show that the development TN-GISs, which can involve hundreds or even thousands of ‘stakeholders’, require a blend of traditional user requirements elicitation methods, as well as several additional efforts which include rapid prototyping, political consultation, consensus building, and other strategies.

1. Introduction
The purpose of this paper is to share the author’s participant performer experience in the development of a particular type of information system – a TN-GIS that aims to ‘connect’ multiple [normally unrelated] government agencies in 25 countries across a continent (and beyond). The TN-GIS is being designed to serve a disparate stakeholder population but is conceptually rather complex. The IS aims to provide a type of ‘international domain’ middleware to enable the exchange and processing of transnational identity data. The aim is to facilitate the creation of ‘cross-border’ government ISs that are secure for the governments and their users. The TN-GIS can also be considered to be an ‘infrastructure’ that could enable citizens, businesses, and administrations to ‘roam’ across borders and access government services in the electronic world. This is similar to that of mobile phone roaming, where users are provided access to services outside of their ‘home’ country without the need to establish new registrations in each location. The infrastructure would additionally allow for cross-border on-line government transactions that don’t involve the physical movement of persons.

The authors have been involved in the elicitation of user requirements for the TN-GIS from governments across Europe. This paper shares some of that experience and reflects upon the utility of existing theories of user requirements building in this context. For TN-GISs requirements engineering we propose a blended approach that is particularly sensitive to political pressures and intent, and an approach that can endure extremely extended development timescales.

2. Typical Approaches to Requirements Elicitation
The process of gathering user requirements, also known as requirements engineering [12], requirements elicitation [8], and the requirements process [11], is a process or stage of development of an IS which sees future users and other stakeholders define what they expect a suggested Information System to do for them. Badly captured or misinterpreted user requirements can result in a system that does not match the intended requirements and thus needs extensive and costly redevelopment.

According to Robertson & Robertson “60% of errors originate with the requirements and analysis activities” [11]. Maciaszek [8] states that “The downstream costs of not capturing, omitting or misinterpreting customer requirements may prove unsustainable later in the process”. The context in which the TN-GIS was developed is one where there could be hundreds and thousands of potential [unrelated] users in twenty-five or more countries. The elicitation of requirements for building a system for this type of user community is atypical and through our participant performer experience with this case we question whether traditional requirements engineering theories are suitable. This leads to our research question:

To what extent are ‘traditional’ requirements elicitation techniques or approaches suitable in the development of requirements for a TN-GIS?
The gathering of user requirements is considered to be an important stage in IS development with several ‘techniques’ having been developed to assist in the correct elicitation of requirements and their inclusion into a system’s design. One of the better known techniques for gathering user requirements is the so-called “Volere Requirements Process”. This process is described as “a generic requirements gathering and specification process whose principles can be applied to both large and small systems”. A simplified abstraction of the Volere Process is presented in Figure 1.

![Volere Requirements Process](image)

**Figure 1: Volere Requirements Process**

This requirements process is independent of the actual systems development methodology that can be deployed. Due to its iterative and evolutionary approach it could be effectively used with a RAD (Rapid Application Development) methodology which can be similarly iterative. Volere does not provide much detail about how requirements can be elicited from ‘stakeholders’.

Maciaszek [8], distinguishes between ‘traditional’ and ‘modern’ methods of requirements elicitation. ‘Traditional’ methods include interviews, questionnaires, observation, study of documentation; and ‘modern’ include prototyping, JAD (Joint Application Development) and RAD. RAD is not strictly a requirements elicitation method but it can be used as such. Maciaszek also proposes that requirements are validated with the ‘client’ using a ‘dependency matrix’ to identify and resolve overlapping and conflicting requirements (pp.87ff). These requirements are grouped into hierarchies so that individual system components, and thus their individual functionalities can become evident. This produces an extra layer of abstraction to the set of requirements as inter-system boundaries become evident and is similar to the function of the Quality Gateway in the Volere Process. The Maciaszek approach is suited to well-bounded IS development.

Sommerville & Sawyer [12] identify three basic requirements activities which are virtually identical to the Volere Process and Maciaszek’s approach. Briefly they are consultation with stakeholders, system documentation, domain knowledge, market studies, requirements analysis and negotiation, and requirements validation. There seems to be agreement between ‘requirements engineering’ authors on the basic activities that are required to elicit user requirements to inform an IS development, producing an IS that fits ‘customers’ needs.

### 3. Methodology

This research has been based on a methodological approach that combines aspects of ‘action research’ [9] with ‘participant observation’ [13]. The methodology is qualitative and based on a single and highly complex case - the development of a pan-European IS for trans-national identity management.

Aspects of this research are necessarily action research because the author’s have been involved in the actual requirements elicitation itself (and other parts of the research and development (R&D) for the IS). The authors participated as part of the object of study and have certainly influenced the outcome. Participant observation also accounts for a large part of this methodology because the author’s were not stakeholders with regards to the system being implemented (i.e. not ‘users’ or ‘customers’ of the IS).

Our approach has been taken to gather as much qualitative case data as has been possible, and to analyse this using a qualitative data analysis package (QSR-NVIVO) in order to identify dominant themes in the data (c.f [7], [2]). The qualitative data includes internal memoranda of the R&D team (including e-mails), the internal notes of the researchers conducting requirements elicitation, feedback from stakeholders gathered at focus group meetings and the like.

### 4. Government Information Systems and Multi-National Systems

Government Information Systems (or e-Government systems) is an area of IS that has experienced rapid growth in the last few years, as evidenced by the large number of e-government projects, large European
Commission research project budgets, and an increased push towards the development of e-Government infrastructure through government agreements and mandates such as i2010 Agenda [5] and the Manchester Ministerial Declaration (Transforming Public Services) [4]. These efforts demonstrate strong political intent focussed on the adoption of government services through electronic means. Governments are attracted to the potential that e-government has in providing administrative cost-savings, the opportunity to provide “e-Inclusion”, and ability for citizens and businesses to interact with government at any point in time without having to physically attend a government office.

The objective of the TN-GIS is to enable the creation of cross-border electronic government services, and its key proponents come from ‘central government’ and institutions such as the European Commission. Their aim is to support broader political agendas such as the free (borderless) movement of people, goods and services [6]. It is envisioned by Europe’s politicians that as citizens and businesses move or transact across national borders, necessary government services should be available in secure and convenient ways to promote freer movement and increased competition. It should be noted that these key proponents are not stakeholders who can provide detailed IS requirements. Detailed requirements need to come from local levels of government who own and run government applications that would use the TN-GIS.

A government agency that intends to implement an e-Government IS needs to account for diverse and demanding requirements often including the associated efforts required in re-designing established workflows that could potentially span several different government departments. Brewer et.al. [3] also note that “design decisions [for potential e-Government systems] are not merely technical or even merely administrative. They are political acts that have important implications for the conduct of public administration and democracy... In this age of increased contracting and outsourcing, public administrators must remain actively involved in designing and implementing e-government information systems”. The ‘active involvement’ is not entirely foreseen in traditional approaches to systems development (see above), where stakeholder input is limited to the requirements elicitation phase and feedback on the resultant prototype or completed system. Therefore, a closer synergy between system developers and public administrators may be required in order to arrive at an e-Government system that meets specified technical and administrative requirements (including in this case trans-national interoperability), as well as its political obligations as an instrument of governance.

Furthermore, governments often need to ensure that information systems and their associated workflows conform to existing legislative provisions (see for example [1]). A trans-national government IS will necessarily be complicated by this factor in that legislative frameworks differ from country to country. The TN-GIS is relatively unique in that it aims to provide services for normally unrelated government agencies in twenty-five different countries. The number of unrelated stakeholders will in the early stages of implementation be hundreds and later thousands. Furthermore, the Identity Management IS that is foreseen would provide services for government’s existing and future IS’s insofar as it could be integrated with existing government information systems to provide cross-border ‘identity services’, or it could be used as an independent IS in itself to provide identity services to non electronic government processes. Figure 2 shows the general topology of the TN-GIS at a very abstract level.

![Figure 2: Government Identity Management Information Systems Architecture](image)

The generic system architecture for the TN-GIS was validated through two large-scale proof-of-concept system trials. These involved a total of 6 national governments and 11 pre-existing e-Government systems, at least 2 of which were in an experimental phase when we initially engaged the governments. The aim of the R&D team was to demonstrate that the proposed TN-GIS architecture had the potential to function in a “real” environment. The R&D team had to therefore find an e-government application domain that would lend itself to demonstrating the ability of the TN-GIS to support one of the basic requirements – the electronic identification of citizens and businesses...
in a cross-border context. This was tricky because existing e-government applications had not been designed with cross-border functionality due to the lack of a TN-GIS such as this.

The two application domains that were chosen by the R&D team in collaboration with several EU governments (The Netherlands, France, Belgium, Estonia, Germany, and Spain) were referred to as E101 and e-Procurement. These application domains were selected for the proof-of-concept demonstrations because the participating governments were nationally active in those application domains and had expressed an interest in the TN-GIS as it provided them with a potential solution to enable their information systems for cross-border transactions.

The applications were also suitable because they involved considerable identity verification and authentication processes. The E101 application (which is based around the traditional paper-based European E101 ‘form’) allows a citizen to be ‘posted’ for work by an employer to another EU country for a period of up to 1 year and provides for an agreement whereby the employee continues to pay Social Security contributions to their country of origin whilst receiving benefits in the country to which they have been posted. The application collects both the citizen’s (as employee) and business’ (as employer) details and these are verified by both countries to ensure that the citizen and business are legitimate, and that they did not have any pre-existing E101 agreement in the previous 3 months. A large number of identity details are shared between two countries and both of these countries must be capable of verifying/authenticating these.

In the course of our requirements engineering activities, one government stated that for the E101 process to function properly there was a need to verify a citizen’s identity details. The existing identity verification method required a citizen to provide their personal details via an on-line version of the E101 form, the data from which was later verified using the country’s identity management infrastructure and processes. This ‘requirement’ was analysed and it was determined by the R&D team that the TN-GIS would therefore require a service called ‘Get Identity Details’. This system service would request identity credentials to be transmitted to the existing E101 application file so that the citizen’s identity could be verified.

Upon presenting our findings to the participating governments, one refused to accept such a service for the TN-GIS as they said that it violated their national data protection laws, which prohibit government agencies from providing identity details to 3rd parties. As a result, the R&D team changed the process and service for verifying identity details by devising a solution whereby the identity details are verified in their originating country, and the TN-GIS provides the ‘foreign application’ with a positive or negative assertion (result of the identity verification process) rather than the identity details themselves. In this example, the legislative framework of a particular country has impacted upon the requirements of the TN-GIS, and the service implementation is significantly different.

5. Preliminary Case Findings

As has been mentioned in the methodology section of this paper, a mixed methodology approach has been employed due to the fact that the authors were active participants in the research and development of the IS in question. The data was collected over a period of approximately two years, since it was not until after a year of employing traditional user requirements elicitation techniques that the author’s realized that the case context was significantly unique and that this would require an elicitation approach that could endure continuous change with a very large number of stakeholders. The authors collected qualitative data for the following two years.

Considering the Volere Process and Maciaszek’s approach to user requirements elicitation, the preliminary findings show that a key area in which existing approaches offer little help to requirements generation for a trans-national government information system is in the identification of relevant stakeholders. Particularly in the field of government identity management, where many governments are implementing national identity projects at many different levels of government (local, central etc.), it is extremely difficult to identify all possible interested stakeholders in any single country. Possible stakeholders not only include e-government application owners but also potential identity providers, and infrastructure and gateway owners (eg. government networks). This is exacerbated when twenty-five countries are considered. Moreover, electronic identity and it’s ‘management’ and ‘ownership’ in any single country or region within a country is also subject to shift between different stakeholders as each develop their own independent information solutions. An identity management system at a pan-European level would not only ‘connect’ a nation’s identity providers, but also the ‘identity consuming’ applications of other countries. Therefore the number of stakeholders appears unbounded.

Additionally, particular government applications require their electronic communications to travel over secure national and international networks, and
therefore such a system as that proposed needs also to collaborate with the ‘gateway owners’ to these networks (e.g. the Trans European Services for Telematics between Administrations network in Europe).

Given the apparently unbounded number of possible stakeholders for the TN-GIS, the development team endeavoured to focus on specific government application areas and to create ‘trials’ [or prototypes] of the IS to support applications in each domain. As has been noted, applications in Social Security and Public Procurement were selected as prototype candidates. The research continued to identify possible stakeholders in these domains and once a smaller subset was identified for prototype purposes, requirements elicitation began.

In the first prototype, Social Security (E101), the requirements team met with government CIOs (of four countries) and their staffs responsible for applications and processes. As the requirements team went from country to country, the requirements list became extremely long, and conflicting requirements due to the legislative provisions of countries began to emerge. The requirements gathering process became extremely protracted because of the variety of requirements (i.e. the list was not becoming saturated in a short timeframe), and to physical constraints such as the availability of the different stakeholders themselves. The time-protraction was further exaggerated by the need (as identified in the traditional requirements elicitation approaches) to iterate in order to verify and clarify requirements.

The complexity of the proposed system and the inability of the stakeholders to arrive at a shared vision caused further complication. It was clear to the requirements team that many of the stakeholders had quite different [and incompatible] views of how the system could be developed, simply influenced by their own national contexts, their own national developments, their own political positions etc. For example some supported the idea of centralized European identity stores for citizen data while others for legal, constitutional, social, cultural, and political reasons sharply opposed even the suggestion of such a solution.

Our preliminary results and the lessons that the requirements team learned from modifying their approach to requirements engineering between ‘prototypes’ produced several interesting and potentially useful findings. It was clear to the requirements team that resolving the very different views the stakeholders had on how such a system could be developed was not going to be an easy task – if not an impossible one. It also became apparent that it was very difficult for the requirements team to really know what the ‘stakeholders had in mind’ as often they were not able to communicate their ‘vision’ clearly (for multiple reasons), but also that their position was usually driven from a national perspective rather than an international one. It also became clear that the variety of issues that needed to be considered for such an information system was well beyond the experience or understanding of any single stakeholder.

In multi-stakeholder focus group meetings involving stakeholders from a single country the participants often reached consensus quickly, allowing for quick decision making and fast information sharing amongst participants (especially when the focus group was chaired by a senior stakeholder). Focus group meetings that involved stakeholders from different countries did not allow for quick decision making and consensus was only rarely reached. The TN-GIS needed to support many countries however.

Reviewing our transcripts of multi-national focus group meetings, we note that these meetings were often dominated by government administration stakeholders promoting their own national solutions and providing reasons why their solution should be adopted internationally (even though this would be impossible), rather than focusing on the problem at hand and attempting to reach consensus. However, where the purpose for a meeting of international stakeholders was aimed at information sharing, most stakeholders were usually very keen to hear the latest results of the TN-GIS R&D team’s developments, and were willing to provide suggestions for improvements.

It seemed to us that for a TN-GIS to be successful, the requirements elicitation process ought to be focused nationally for detailed requirements gathering, whilst the requirements for the international domain functionality of such an application must be decided by the independent R&D team itself who presents a number of solutions to an international audience. In other words, mid to low-level decisions can not be reached at international requirements engineering workshops, whilst high-level decisions can be reached if the possible outcomes are presented as suggestions by an independent 3rd party. We see this as essential if one wants to avoid delays through eliciting requirements from an inappropriate combination of stakeholders. The Volere process, Maciaszek and other Requirements Engineering authors recommend workshops/focus groups as a valid tool for gathering requirements for an Information System, provided the appropriate audience is present. We caution that the appropriate audience for requirements gathering of TN-GISs depends on the particular aim of the workshop/focus group and that it is extremely difficult to obtain consensus from an internationally-composed government stakeholder group. Our experiences show
that it is easier to obtain consensus at a national level and allow the R&D team to act as the “gel” between disparate groups of stakeholders, and thus disparate groups of requirements.

With this experience the requirements team decided to produce a multi-lingual mock-up version of an e-Government application that was ‘enabled’ by the trans-national identity services that would eventually be provided by the proposed IS. This way, stakeholders were able to better ‘visualize’ what was proposed and this helped them to ‘frame’ their requirements in the context of something tangible and ‘real’. This approach proved extremely successful.

The requirements team used additional ‘techniques’ such as political consensus building, information dissemination, and focus group consultations. We plan to provide a more detailed and systematic analysis of these approaches in future publications of this research.

6. Conclusion

The uniqueness of the information system being developed produced significant challenges for the requirements elicitation team and indeed the entire development team. We have aimed to share our preliminary research results to describe our experience in using traditional requirements engineering approaches for the development of a highly complex information system. The most salient results to date can be summarized thus: government information systems may require political consensus that is difficult to build, the multiplicity of stakeholders on a trans-national basis presents several challenges which include the difficulty in achieving consensus on requirements, the difficulty in achieving a shared vision for the proposed system (even at a high level), and particularly the difficulty in managing extended development cycles. The identification of stakeholders and the management of disparate requirements are key areas in which traditional requirements approaches provide little guidance but are critical in a trans-national government setting. The TN-GIS has yet to be put into production.

7. References


