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STAKEHOLDER ORIENTED ANALYSIS FOR INFORMATION INTENSIVE APPLICATIONS

A CASE STUDY

Research-in-Progress

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Abstract

We present an approach to Requirements Elicitation based on AWARE, a goal oriented technique conceived for Web applications. The approach integrates a goal-oriented analysis of the needs of each stakeholder class with a subsequent phase of function-oriented analysis. Goal-oriented analysis facilitates an active participation of users and, therefore, can be considered as a substantial step towards user acceptance of the system. Our approach introduces the use of predefined diagrams of user's needs and confirmation/disconfirmation interviews, that eases and fastens user interaction. The approach was tested on an Information Intensive Application, namely a collaborative document management system for a fast growing Management Consulting organization. The system will support both marketing activities and consulting work on the whole life cycle of consulting projects. In our case study the goal-oriented approach actually encouraged active participation of future users in the dynamic and unstructured environment typical to a Management Consulting organization. The active user participation helped analyst to maximize the potential value supplied to each professional and to minimize the future effort required to use the system. The consulting organization is currently implementing the system and decided to adopt the approach also for their customers.

Keywords: Document Management System, Systems Analysis, User Involvement, Analysis Techniques, Systems Design

Introduction: User Acceptance and Satisfaction as Drivers of IT Success

Information Systems Science is composed of interrelated areas, that could be grouped in three main areas, namely Business, IT and Social-Organizational (Spohrer et al. 2006). When designing an IT solution, analysts and managers should consider that the mere implementation of IT can achieve the expected results only if appropriately supported by changes or innovations in other perspectives: indeed, the fear to be replaced by IT systems (Markus 2004) may generate a resistance against a new technology may drive to unanticipated consequences (Benjamin et al. 2001).

“IT is an effective implementation vehicle of innovation, but only when coupled with the approach, enablers, and other implementation factors” (Davenport 1993) “IT plays a fundamental role in business reengineering, but one that is easily miscast. State-of-art information technology is part of any reengineering effort as, an essential enabler [...], since it permits companies to reengineer business processes. But to paraphrase what often is said about government and money, merely throwing computer on an existing business problem does not cause it to be reengineered” (Hammer et al. 1993). The relationships between success of IT projects, user acceptance and satisfaction is a focus of different research streams.

A common research assumption is that user acceptance leads to the actual use of a system. A first research issue is measuring acceptance, by scales and indicators to frame user behaviors when approaching or accepting new IT solutions/innovation (Gibson 2004; Rogers 1995). The perceived characteristics of innovation can be described by several classes of variables e.g. ease of use and relative advantage (Davis 1989), compatibility, image, result demonstrably, visibility, and trialability (Moore et al. 1991). These variables have been used to define different acceptance models, that define cause-effect chains and allow to predict acceptance behaviors. The major acceptance models are Technology Acceptance Model - TAM (Davis 1993), Theory of Planned Behavior - TPB and Decomposed TPB (Ajzen 1985; Ajzen 1991). The most effective in predicting the usage is TAM (Davis 1993). TAM is extended with new indicators and scales (Schepers et al. 2007; Venkatesh et al. 2000) and with context variables (or moderation effects) of three main categories: Organizational, Technology and Individual factors (Sun et al. 2006).

Another research assumption assumes User Information Satisfaction (UIS) as a proxy measure for system success (Ives et al. 1983). Of course user satisfaction is one of the success drivers not the only one, as it emerges from several research studies (Delone et al. 2003). User satisfaction could be decomposed into Information and System satisfaction (McKinney et al. 2002). Central in the satisfaction field is the concept of disconfirmation (Kettinger et al. 1994). Essentially, satisfaction is measured by the gap between ex-post perceptions of the system and ex-ante standard expectations.

User satisfaction appears to be related to the involvement in system design: involvement leads to a deeper understanding of the system and, therefore, it potentially narrows disconfirmation. Based on a comprehensive survey McKeen (McKeen et al. 1994) finds that “Participation”, “Communication with the developers” and “Influence on the design” positively affect the satisfaction of end users. Finally, user satisfaction could be related to the user acceptance of the IT innovations (Wixom et al. 2005).

User oriented analysis techniques are a means to enhance user acceptance and to some extent user satisfaction, by common sense an ideal technique of this kind should be easy to understand by users as precise for the subsequent phases of the system development. Furthermore it should produce an effective vision of the whole system and for the various user classes.

The Issue of User Participation and User Oriented Requirements Elicitation

We can easily assume that Requirements Elicitation (RE) is the key design phase to get users involved and participative. According to the Rational Unified Process “A requirement describes a condition or capability to which a system must conform; either derived directly from user needs, or stated in a contract, standard, specification, or other formally imposed document” (Jacobson et al. 1999). In a broader perspective "a requirement is just an information unit – a piece of information about the system under construction – that is important to keep" (Stevens et al. 1998). This definition embraces also constraints, assumptions, plan items, term definitions, etc.

The term "elicitation" is usually preferred to “capture”, to avoid the suggestion that requirements are out there to be collected simply by asking the right questions (Jirotko et al. 1994). RE can be defined as the process in which

information about “what to get” is obtained from key users. The term “elicitation” implies that the analyst is not directly asking users about their respective information requirement but extracts them from their key variables. A very classic example is CSF (Rockart 1979) where the analyst asks managers their own Critical Success Factors (CSF), identifies CSF metrics and, finally, identifies information sources and information reports. Actually the analyst does not ask what information manager needs since they probably do not know and/or have no time to perform such analysis. In short CSF offers a well known and classical paradigm of information RE.

A second critical point in RE is the variety of users. Actually users can be regarded as stakeholders of both the business processes the system serves and the process itself. “A stakeholder in an organization is (by definition) any group or individual who can affect or is affected by the achievement of the organization's objectives.” (Freeman et al. 1984). A similar definition is given by Eric Rhenman (Rhenman 1968) and, by Poulondi (Pouloudi et al. 1997) in the IS domain and in the software engineering by (Conger 1993). In systems different user/stakeholder classes/roles can be identified: (a) daily users who only operate on the system, without any specific awareness, (b) power/key users who are aware of the business logic incorporated in the systems (c) process owners, who are managers in charge of the process the system supports (d) occasional users as it happens with web-oriented applications.

In order to understand the needs of stakeholders, an analyst should explicit their vision and diverse viewpoints (Longo et al. 2006; Motta et al. 2008). Traditionally RE is accomplished by conceptual modeling techniques which propose an abstract view (Goguen et al. 1993), that concentrates on what the system should do. Whereas traditional conceptual modeling allows us to understand the semantics of information, it often fails in enabling acceptance by users. Research shows that many large projects fail because of an inadequate understanding of the requirements (Boehm 1981). This inadequacy is often related to social, political and cultural factors (Schein 2004), as stated by Davenport “IT is an effective implementation vehicle of innovation, but only when coupled with the approach, enablers, and other implementation factors” (Davenport 1993). The effort needed to fix these systems has been found to be very high.

In order to get participative and effective RE a possible way is to focus on the goals of stakeholder classes and elicit the implied information requirements. The concept of goal is prominent in recent approaches to RE. Specifically, Goal Oriented Requirements Engineering (GORE) approaches emerge in this research area.

Goals are prescriptive statements of intent whose satisfaction requires the cooperation of actors (or active components) in the software and its environment. According to Pohl (Pohl et al. 1997) “goals represent the objectives an actor wants to achieve when requesting a certain service” and it “is used to describe an objective to be achieved in the macrosystem, e.g. business goal, personal goal etc.” Rolland links the concept of goal to the concept of stakeholder's hope “A goal is defined as something that some stakeholder hopes to achieve in the future” (Rolland et al. 1998). Other definitions come from Van Lamsweerde (Van Lamsweerde 2001) and Dardenne (Dardenne et al. 1993).

Goals have different level of granularity from high-level, strategic objectives to fine-grained, technical prescriptions that can be assigned as responsibilities of single actors.

Goal-Oriented Requirements Engineering (GORE) uses goals for eliciting, elaborating, structuring, specifying, analyzing, negotiating, documenting, and modifying requirements (Van Lamsweerde 2001). GORE focuses on early requirements, when problems are identified, and alternative solutions are explored and evaluated. During goal-oriented analysis, the analyst begins with initial stakeholder goals such as “Fulfil every customer request” and refines them until goals are reduced to alternative collections of functional requirements. Major models that use GORE include:

- Knowledge Acquisition in automated Specification – KAOS approach (Dardenne et al. 1993) that consists of a formal framework based on temporal logic and AI refinement techniques.
- Non-Functional Requirements (NFR) approach is based on the notion of soft-goals. A soft-goal is satisfied rather than achieved (Mylopoulos et al. 1992).
- i* (Yu 1997) develops NFR but it is more focused on the current organizational situation. In particular, it relates organizational stakeholders, goals and candidate software architectures.

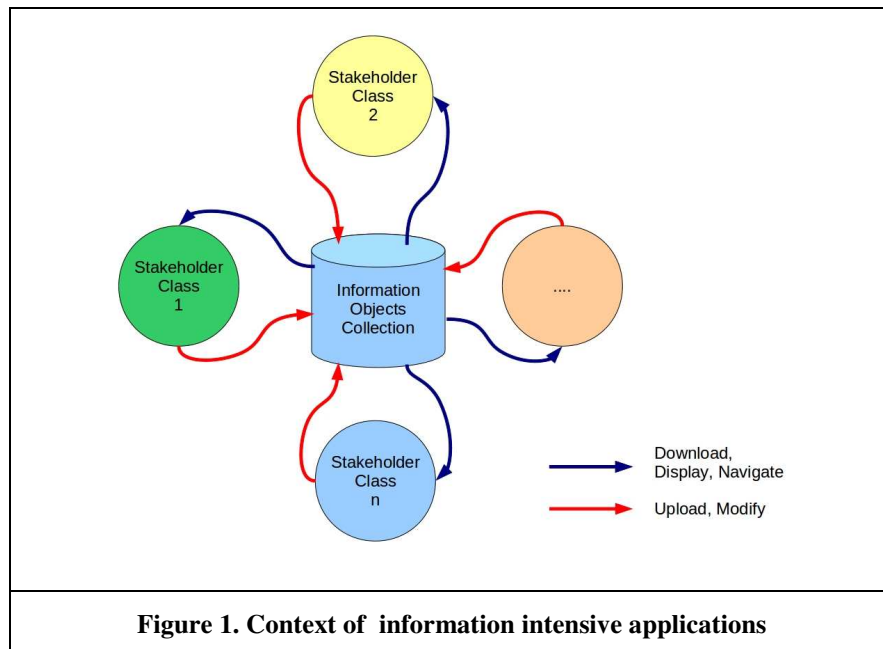
Goal-Oriented Requirements Elicitation (GORE) Methodology to Improve User Participation

From the above sections on Requirements Engineering (RE) issues, we can draw an ideal paradigm of RE approach

- RE techniques should support user involvement, that could be considered a step toward User Satisfaction
- Elicitation of requirements implies an active participation of users; in order to get participation the RE language should be immediately understood by users
- Requirements should be specific to each class of stakeholders since different stakeholders have different needs and goals
- Elicitation should begin with stakeholders' goals and not with system functions; however functions should be easily identified starting from a goal-oriented description

Analysis of Web Application REquirements - AWARE (Bolchini et al. 2004), that supports the early interactions between users and analysts reasonably fits the above paradigm. AWARE is very simple, directly links goals to requirements and provides straight definition of requirements categories (Access, Presentation, Operation, Navigation, etc...). AWARE, has been already successfully used to elicit requirements for Ubiquitous Web Applications (Perrone et al. 2003). Our purpose is twofold, namely a case study on information intensive applications and the integration of a goal-oriented requirement elicitation with the subsequent phase of a function-oriented RE.

Let us justify the case study. Information intensive applications such as document management, knowledge base systems, information repositories are close to the paradigmatic web applications. Indeed the primary needs of users are to access/navigate and/or load information objects. AWARE fits the domain of information intensive applications. First, the context of information intensive applications can be described as a community of diverse users/ stakeholders which interact with a collection of information objects (Figure 1). The AWARE syntax defines the interaction of each stakeholder class independently from the other ones, and, therefore, generates as many need schemata as many stakeholder classes.



Second, each individual user describes in a friendly notation which goals and actions is willing to do on the collection of information objects he or she is dealing with; the friendliness helps communication with and between users and, also, enables analysts to elicit structured requirements. Let us consider the information needs of a "Senior Consultant" stakeholder class (Figure 2) in a consulting organization (more detail is in the case study section). The

stakeholder says or confirms to the analyst his / her goals about the use of information objects. Goals are decomposed until appropriate detail is obtained. Eventually, the stakeholder identifies the actions that he or she will do to achieve goals. The actions will be further structured by the analyst into Use Case.

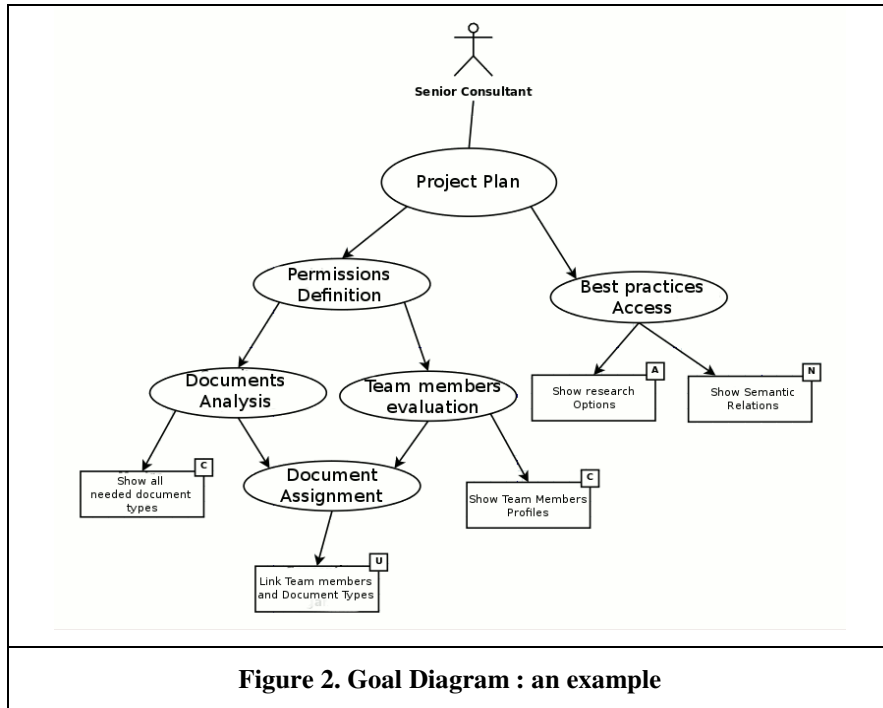


Figure 2. Goal Diagram : an example

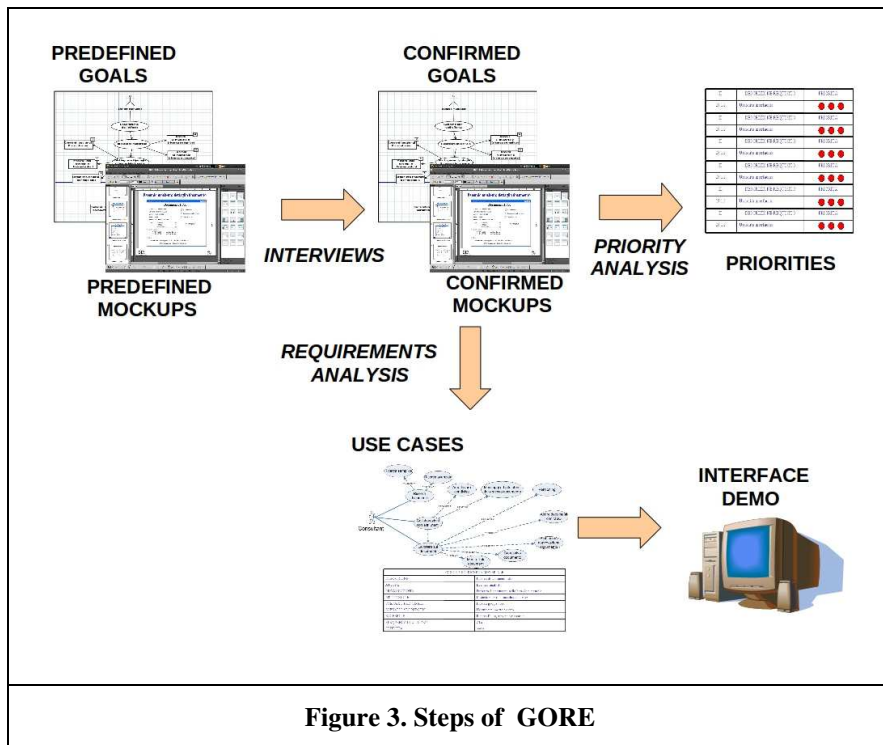


Figure 3. Steps of GORE

Let us come to the second purpose, namely the integration of goal-oriented analysis with function-oriented analysis. The overall analysis flow is illustrated in Figure 3. It reflects a gradual approach from stakeholder needs to systems

design. A preliminary phase identifies the domain of information objects to be addressed and the stakeholder classes which interact with information objects. This identification can be obtained by cataloguing information objects and analyzing organization manuals; however it is easier to include a key user in the analysis team. The output is a draft of AWARE goal diagrams and mock-ups of Graphical User Interfaces (GUI).

The preliminary picture of user needs should be confirmed. Therefore, in a second phase, analysts interview a sample of stakeholders to confirm / disconfirm the preliminary picture versus the actual needs. Users are not asked “What information are you needing?” but “Are these the goals you are pursuing?”, “Is this the interface you are comfortable with?”, “Is this the navigation you want?”.

Once needs have been confirmed, requirements priority levels can be defined and needs can be transformed into Use Case diagrams. Each action defined in the goal diagrams identifies a candidate use case. To develop Use Cases the analyst can rely also on mockups and notes on the action.

GORE in Consulting Groups: a Case Study

The Management Consulting Group

Our project refers to a management consulting group. Founded in 2003, Business Integration Partners (BIP) grew so successfully that is now the largest Italian management consulting with over 400 consultants. BIP (www.businessintegrationpartners.it) operates in the area of strategy/organization structure & business processes with a focus on IT governance. Customers are very large corporations in Telecommunications and Utilities. BIP is also in Spain, Portugal and Argentina and, through international alliances, in France and the Far East

BIP runs some 250 projects at a time. Management consulting projects are about program management of large IS projects, audit, business process reengineering, IT governance. The project life cycle includes the phases of Proposal, Planning, Execution.

In the Proposal phase consultants respond to a request made by the management of a customer company. Proposals generally include a presentation, a quotation, a negotiation activity and the finalization of the actual proposal. Key documents in this phase include (1) References in similar projects and companies, (2) Project plan and organization, (3) Technical proposal, (4) Project costs, (5) Resumes of consultants. The Planning phase follows if the proposal is accepted. The appointed project leader I staffs the project and defines detailed deliverables and milestones. Finally, in the Execution and Delivery phases consultants write documents and/or attend meeting with customers. Generally this phase generates a collection of progress and / or intermediate reports and it ends with the final report.

Stakeholders in BIP reflect very closely professional levels, that are very similar to other major consultancies. The *Business Analyst* are junior consultants and typically write documents. *Consultants and Senior Consultants* have more extended experience and deal with harder issues and/or coach Business Analysts. *Managers and Senior Managers* manage project teams. Senior managers actually put together proposal and plans. Finally, *Partners* are the top professional level; they manage customers of a given industry.

The issue: Document Management (DM) in a management consulting group

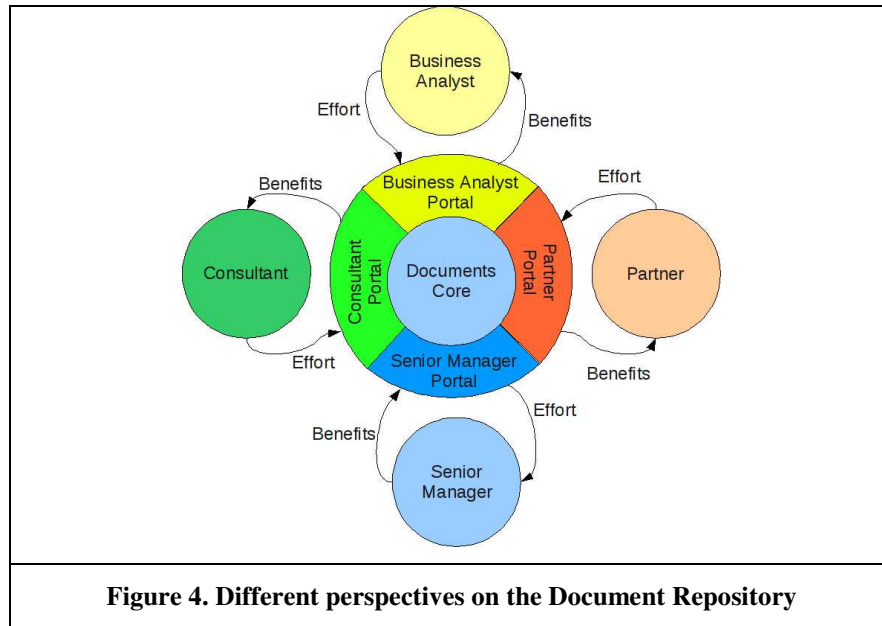
DM in a Management Consulting company serves a dynamic community that spins around complementary axes, that are the professional profiles and the projects. This twofold dimension multiplies ownerships of documents. For instance, Senior Managers are interested both in general templates and in documents of individual projects. This double ownership is typical to the wide range of project oriented industries as high technology, aerospace, research and alike. While database is typical to project oriented industries, the document is the typical artifact of professional organizations, such as lawyers, notaries, physicians and of course consultants.

BIP top management were persuaded that knowledge is a primary corporate asset. Actually it shortens the time of delivery by providing pre-configured documents and appropriate references, it makes education of junior people

much easier by providing best practices and document templates. Finally, it allows cross fertilization between teams and transforms individual knowledge into a corporate asset.

However, an internal survey pointed out that the existing system was only a partial success. A cumbersome interface made access very complicated and the effort of uploading documents was based on highly controlled ad-hoc procedure. Such user unfriendliness and inefficiency could not be accepted in a context where non billable time is considered a waste.

Finally, interviews of senior managers pointed out that the document management system should be profiled on each professional profile. Senior managers when working on a new proposal are interested in finding out similar proposals while business analysts look for templates and document examples to produce new consulting reports.



Based on this experience, the principles of the future DM system were stated as follows:

- **Zero-cost tagging and smart loading:** loading a project document should be a costless extension of a routine action such as sending an email and/or save a document; tagging should be smart and automatically associate information from project data and document meta-data. Also ubiquity is a must: consultants should access via browser all functions, since they spend most time outside the office
- **Highest value to stakeholders:** the systems should provide each professional profile with useful and necessary contents (e.g. best practices). This implies an enterprise repository where each consultant can find his own documents, applicable templates, appropriate selection of documents of the projects he is working on and public documents that are shared by the professional profile community (Figure 4)
- **Document and project segregation:** the hierarchy of privileges coincides with the hierarchy of projects. The team leader validates / authorizes documents of his team, the senior manager makes the same across teams; this is a key for a consulting company who should keep consulting teams segregated for the sake of customer's privacy. Actually the system tracks downloads and forces planned confidentiality constraints.

The Analysis

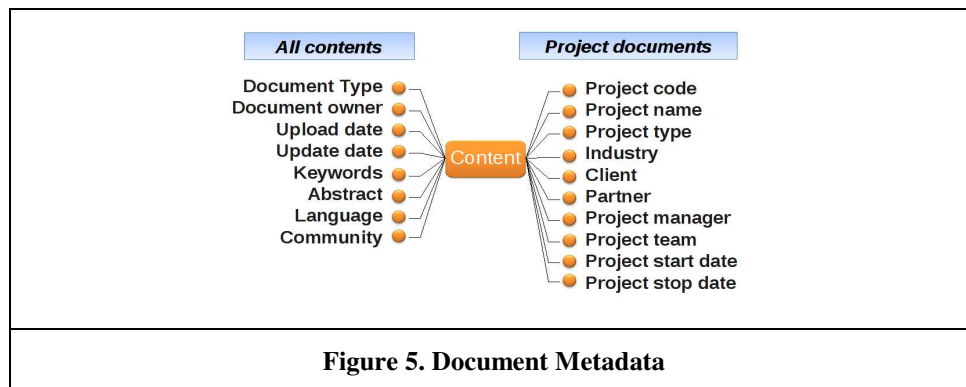
Before starting preliminary goal diagrams, we discussed with the key users appointed by top management a short document. The document defined the user scenario of the DM system, and identified in plain English the needs of each stakeholder class. Afterwards, as in the methodology framework, we prepared preliminary diagrams and mockups and we selected together stakeholder representatives to be interviewed.

AWARE diagrams proved to be not only very rapid to draw but also immediately understood and easily integrated by screenshot, navigation diagrams and use case descriptions. An unexpected result was additional goals added by interviewed persons (1-3 for each stakeholder class). An example is the idea of tagging documents based on the navigation performed by the user. Also the system automatically proposes documents that all the colleagues downloaded when performing similar searches. This successful and rich analysis hardly would have been feasible with traditional structured approaches, that lack of participation, or informal participative techniques, that lack of structured output.

In order to foster participation we managed that every interviewed people and every interviewer could track his own suggestions on a log of proposed changes and additions regardless of whether they were incorporated or not. This was a successful idea for participation and aided in prioritizing suggestions. Loading DM by project emails, discussed here below, was one of these suggestions.

Finally we have to mention a philosophy that really drove all the design that we call “Zero-cost” i.e. the user whoever it is should spend only a marginal effort to load or access the DM. High effort is a primary failure cause not only in consulting but in most information intensive systems. Users by instinct balance the value received against the effort spent. In Figure 5 we show the meta data of a document. Administrative meta data are extracted from corporate ERP while document meta-data come from tags of the loading tools, that can be email, web portal and batch for initial population.

In the actual project, after the Requirements Elicitation phase, benchmarking and prototype activities gave proof of concept and fit-gap analysis against main proprietary and open source Document Management Systems. The system is now being implemented. BIP has also decided to adopt the extended AWARE methodology as a reference technique to audit / evaluate strategic information requirements.



Conclusions and Future Developments

Within the obvious limits of a single case study, we have illustrated a goal and stakeholder oriented approach to Requirements Elicitation (RE). The case study is about document management in the peculiar context of a management consulting organization. Generally, AWARE paradigm proved to be suitable to information intensive applications and to a very dynamic environment. Also the methodological refinement used in the case study has fostered user participation. Actually:

- Goal Diagrams were immediately understood by users and GUI mockups enabled a loose simulation during the interviews;
- Predefined diagrams enabled confirmation / disconfirmation of user needs: users saw diagrams they could read; also, they discussed and critically assessed needs; nevertheless the analysis was fast (two hours per interview).

Future developments should confirm the good quality perceived in RE phases and, more important, should assess the user satisfaction of the application implemented. A second development is on analysis tools, namely a tool to sketch goal diagrams and related documentation and also a knowledge base to store best practices (predefined goal diagrams and alike documents).

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