

D1.5 Web Engineering Methodology and Development Manual

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Abstract: This document aims in providing a framework for developing e-business enabled SMEs in the context of a Leveraging Centre network, like e-MINDER. The framework is based on the web engineering concepts and principles. Web engineering is a methodology which can help companies to create successful web information systems. In this deliverable we extend the web engineering methodology to e-commerce, leading towards an e-commerce engineering methodology. It is expected that the methodology will provide the SMEs information about web engineering principles along with appropriate procedures and guidelines for the analyst in order to assist the SMEs in becoming e-business enabled.

Keyword List: web engineering, e-business, leveraging centre, business reengineering process

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1. Introduction (Purpose of developing a methodology and development model)

The purpose of this document is to provide a precise and clear guide for the methodology and the development model based on web engineering concepts and principles. This model aims to provide a knowledge source and a tool for the e-MINDER network of leveraging centres. As a knowledge source this documentation will try to capture and present the procedure of developing e-business enable SMEs in the framework of a Leveraging centre, like e-MINDER.

This manual, also, aims to become a necessary tool for the leveraging centre. It will introduce a framework and methodologies for developing web information systems for perspective e-business enabled SMEs and it will also present the procedure for developing e-business enabled SMEs. A web information system, that is, a website that could be either simple or extremely complex, having many functions is not the only thing that could drive an SME to become e-business enable. It is clear that it is not so simple to define what a web information system is and it is rather complex to develop and implement web information systems without having the right tools.

Current trends in the market have invented two major concepts that we can use to help us follow systematic approaches towards our target, which is the successful development and implementation of web information systems. The first of these two concept is the “e-business engineering” where the second is the “web engineering”. E-business engineering covers the area of engineer or re-engineer an enterprise in order to transform it to an e-business enterprise. This can be achieved by redesign the enterprise’s business processes in a way that by the use of information technology one can increase the efficiency, effectiveness and the productivity of the enterprise. In this manual we will focus on the web engineering concepts and principles and how this can be used in the context of the e-MINDER leveraging centre. The e-business engineering strategy will be discussed in the Leveraging Centre Handbook.

Web engineering is important to e-MINDER because the methodology is very tightly coupled with web information systems. A web information system is considered to be a very important element of any modern e-business. Note that sometimes a misconception is that e-business is taken to be simply a web information system; but this is not correct. An e-business is far more than a web information system. Since a web information system is a crucial element of an e-business we need to find ways to build successful web information systems. Web engineering will assist us to help in the creation of a successful web information system.

By writing this manual we target to equip the e-MINDER leveraging centre with a framework that uses web engineering concepts to develop such e-business systems.

In the e-MINDER leveraging centre framework, apart from the technological part and the web information system development, we are also concerned with other aspects of the “e-business enabled SME”. Some of these viewpoints are the human factor, the enterprises business processes, the market and the industry of the enterprise and many more.

The aim of e-MINDER project is to develop a general Web Engineering Methodology and Development Model so it can be used by the leveraging centres of the e-MINDER network.

In section 2 we provide a theoretical approach for the concept of “web engineering”. Our target is to familiarize the reader with the, so far, known scientific terms and concepts that govern the generation of the web engineering and our adaptation for e-business in the context of e-MINDER. In section 3 we present and analyse the proposed model we have developed to become both a valuable knowledge source and a tool for the e-MINDER leveraging centre. The tool will cover mainly the development cycle process of a web application and it will particularly emphasise factors that have direct and indirect impact on the SME operation and business processes. However, in this section we do not underestimate other known and unknown viewpoints of the procedure “leveraging an enterprise to become e-business enabled” other than technology such as human factor, market etc. We have focused to provide a clear and simple to implement and use methodology (or tool) for developing e-business enabled SMEs in a way that it can be used by the e-MINDER leveraging centre or other similar leveraging centres. The methodology presented in this deliverable is general in order to be able to adapt to each Leveraging Centre. Due to this generality in section 4 we present the implementation of the methodology as it was implemented in the 3 regions by each Leveraging Centre and how it was applied in SMEs that wanted to become e-business enabled. Finally in section 5 we present some issues we consider very important for the implementation of successful e-commerce applications. In this section we present concepts on security, user interfaces and technical infrastructure. We believe that these concepts are very important for the web engineering process and it worth’s seeing them in a more detailed way. Further more these concepts have to be considered in the design and implementation of an e-commerce Leveraging centre as e-MINDER.

2. Theoretical Background/Overview

2.1 Web Engineering: Introduction and Perspectives

This section addresses some of the most fundamental themes of Web Engineering and in the same time it tries to explain the significance and the usefulness of Web Engineering from the

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e-Commerce viewpoint. In the context of identification and promotion of Web Engineering as a new discipline for the development of Web-based systems and applications, several questions naturally arise: What is Web Engineering? When is it needed? Is there an illustrative case study that would highlight the arguments? What is the relationship between Web Engineering and e-Commerce?

2.2 Web Engineering: A New Discipline for Development of Web-Based Systems

In most cases, development of Web-based systems has been ad hoc, lacking systematic approach, quality control and assurance procedures. Hence, there is now legitimate and growing concern about the manner in which Web-based systems are developed and their quality and integrity. Web Engineering, an emerging new discipline, advocates a process and a systematic approach to development of high quality Web-based systems. It promotes the establishment and use of sound scientific, engineering and management principles, and disciplined and systematic approaches to development, deployment and maintenance of Web-based systems. An e-Commerce system is a case where we can apply the Web Engineering discipline. E-Commerce systems are mainly Web-based systems, thus the processed and the systematic approaches described within the Web Engineering framework can be applied in the development of a Web-based e-Commerce system.

2.3 Web-Based Systems Development: Process and Methodology

2.3.1 Web-Based Systems Development: Process and Methodology – Overview

The engineering approach places a strong emphasis on product and process modelling. The previous section defined and elaborated on what Web Engineering is and why it is needed. This logically leads to questions about product and process modelling or methodologies. How well do the currently available models meet the needs of Web Engineering? Do we need to create new models and why? Are there examples of good and bad practices that one can learn from?

2.3.2 Web-Based Information Systems Development

Web engineering is more complex than traditional Information System (IS) engineering in that it raises many new issues such as presentation issues, user profiling, navigation support, etc. This paragraph presents a method - a set of product models along with process models for the development of WIS.

This method discusses user modelling and customisation to Web engineering. By capturing the user profiles, the designer is able to define user categories and to tune the presentation of the WIS content according to the specificity of the user. Besides, by capturing the user goals, he/she is able to define guidelines for navigating in the Web in order to optimize the satisfaction of the user needs.

2.3.3 Web Services Development and e-Business Engineering

Developing e-business systems is a complicated task. It involves many different disciplines and requires knowledge of e-business technologies as well as business processes. In this paragraph we look into what causes this complexity, and discuss an approach to overcome the current barriers in e-business engineering.

The approach combines knowledge of processes and technology with a new e-business engineering methodology, called Rapid Services Development (RSD). The ingredients of RSD are discussed in detail, and linked to current engineering approaches.

2.3.4 Web Maintenance and Reuse

The importance of maintenance of Web sites and applications has already been widely recognised. From a logical point of view and from the understanding derived from developments in Object Oriented methods, it is also clear that reuse of what exists, will always help in reducing the costs and the time for developing and maintaining Web-based systems. We also need to think about the maintenance and update process of the content of a Web-based system. This type of maintenance is somehow different from what we used to know and we have to find ways to deal with it. The ideal would be to have this process integrated in the systems operation.

3. A Framework for Developing Successful E-Business Systems

3.1 Framework Introduction

Taking into consideration the importance of requirements and the immediacy in deploying e-commerce applications (Norton, 1999) this work introduces a new development framework which aims at improving the quality of e-commerce systems accommodating small-to-medium enterprises (SMEs) by addressing the issue of complexity of the application to be produced and the associated time and man-effort resulting by this complexity. This framework is based on a special form of the Business Process Re-engineering (BPR) that assesses various aspects related to the client organization. This assessment assists the

identification of critical business and organizational factors that contribute to the complexity of the e-commerce system. The critical factors identified are combined with significant issues arising from the specific application domain and the requirements describing the desired quality. All this critical information is then transformed into measures of complexity that drive the decision as whether the development process of the system should follow a certain version of the known WebE process (Pressman, 2000), either a short process cycle (SPC), or a full, long process cycle (LPC). The terms “short” or “long” refer to the time-bounds of the process and the required effort to be put by the human resources of the developer. The framework is demonstrated with two case studies: (a) An SME wishing to go e-commerce with a medium e-business awareness, and (b) An SME with satisfactory e-business awareness that aims at enhancing its existing simple e-commerce system.

The proposed framework defines three primary categories of critical factors that affect the complexity level of an e-commerce system and the length of the development process: (i) Business and organizational issues, (ii) Application domain aspects, and (iii) Quality requirements. We will move to examining each category in detail and analyzing its level of contribution to the overall complexity of the system under development. We will provide a sample step by step guide for each category. The guide’s purpose is to help in a practical way to assess the complexity level of each category.

3.2 Business and organizational issues

Business Process Re-engineering (BPR) can help organizations attain better productivity by dramatically changing existing business processes. Grover and Malhotra (1997) identified five critical issues that define BPR: (a) BPR consists of radical or at least significant change, (b) BPR’s unit of analysis is the business process, not the department or functional area, (c) BPR’s purpose is to achieve dramatic performance improvements, (d) Information Technology (I.T.) is a critical enabler of BPR, and (e) Organizational changes are a critical enabler of BPR.

Performing successful BPR requires seven phases (Covert, 1997): (a) Begin organizational change, (b) Build the reengineering organization, (c) Identify BPR opportunities, (d) Understand the existing process, (e) Reengineer the process, (f) Blueprint the new business system, (g) Perform the transformation.

The proposed framework utilizes the BPR in an attempt to assess the current state of the organization, to explain the need for change, and to illustrate the desired position it aspires to capture via the e-commerce system. This process can reveal critical factors about the client organization and the business performed that orient the answer to the question whether the

organization is ready to move to e-commerce and give indications as regards the level of the development effort needed for building a new or modifying an existing system.

The Business Assessment (BA) is the first set of activities the software analyst must adopt, placing emphasis on three key areas: (a) Business goals, (b) Market aspects and (c) Human resources. Business goals are the primary determinants of the type of the system to be developed. Achieving these goals means examining the market and deciding where and when the organization wishes to bid the market and investigating whether the human resources of the organization are adequately trained and willing to support the new processes. Analytically:

3.2.1 Business Goals

The software analyst investigates the business perspective of the client organization and transforms it to the type of services needed for the e-commerce system to promote this perspective. These services are then assessed in terms of feasibility and complexity. Certain types of services may not be feasible due to unrealistic technical requirements, budget limitations or time constraints.

3.2.2 Market Aspects

The analyst and the management investigate whether the demands of the marketplace are shifting. If this is the case then new and innovative services may need to be developed, something that leads to demanding a higher level of development effort. If not, then the analyst and the organization explore ways for developing better e-business applications and processes than those offered by competitors who have already made significant advancements in products or services, or in online business. Analysing market competitiveness will provide a clear view as to the upper time bounds of the development process and will also reveal the type of services that must be offered to win the competition or at least be equally competitive.

3.2.3 Human Resources

Management and personnel may also hide critical success factors in developing an e-commerce application. Therefore, the analyst takes into consideration several human issues which can be decomposed into the following categories and corresponding elicitation activities:

1. *Management Awareness and Involvement* – Explore management awareness about e-commerce in general and true involvement in the project. Also, define the level of management support and the areas in which it will be involved.

2. *Personnel Training* – Identify the key personnel that will be involved in the re-engineering process, their level of education, the areas that need to be further trained and the available time bounds.
3. *Human, Social and Organizational (HSO) Factors* – Investigate HSO factors that may affect the system development or slow down the re-engineering process, such as communication and collaboration issues, personnel's willingness to change their working procedures, user expectations of the system, whether users feel threatened by the system in terms of current posts or job loss, etc.

3.2.4 Action List

We will provide a suggested action list with questions that can help assessing the business and organization issues of the SME. The reader can use this sample action list in order to make estimations about the complexity factors in table 2.

1. Business Goals
 - a. Investigate the business perspective of the SME.
 - b. Transform the SMEs perspective to the type of new services needed for an e-commerce system.
 - c. Assess new services feasibility in terms of technical requirements, budget and time limitations.
 - d. Assess new services complexity in terms of technical requirements, budget and time limitations.
2. Market Aspects
 - a. Investigate the demand for these services.
 - b. Define Competition
 - c. Analyse market competitiveness for these services.
3. Human Resources Issues
 - a. Define management's level of awareness and involvement
 - b. Identify the personnel's involvement and it's level of knowledge.
 - c. Identify significant HSO factors within the SME which are important and they might affect the systems deployment.

After going through this action list the reader should be able to assess the business and the organizational issues of the SME. He/She would be able to estimate the factors C1,1, C1,2 and C1,3 in table 2. In order to do this he/she must also consider section 3.5.

3.3 Application Domain

The categorization of the various types of Web applications assists in estimating their level of complexity and the development effort required. Dart (1999) provides the following most common application categories reported in the Web engineering literature:

1. Informational – Read-only content with navigation and links.
2. Download – Information available for downloading by the user.
3. Customisable – Content can be customized based on user needs.
4. Interaction – Communication among users via chat rooms, bulletin boards, or instant messaging.
5. User input – Communication via online forms.
6. Transaction oriented – Order processing (products and services).
7. Service oriented – The application provides an online service (e.g. estimating a mortgage payment).
8. Portal – A starting point that channels the user to other Web applications outside the domain of the portal application.
9. Database access – Querying a database and retrieving information.
10. Data warehousing – Querying a collection of large databases and retrieving information.

3.3.1 Action List

In order to assess the application domain of the desired e-commerce system and fill the be able to estimate the factors C3,1 – C3,10 in table 2 we propose the following action list.

1. According to the business goals of the client organization a certain Web application type or combination of types above is selected for implementing these goals.
2. By linking the type of application to the quality requirements described in the next subsection (3.4) the analyst can discover the contribution of the application domain characteristics to complexity, i.e. receive indications as to how difficult and complex to develop will the functional part be.
3. Estimate the degree of complexity according to Action 2 and rank factors C3,1 – C3,10 in table 2. In order to do this also consider section 3.5 for the ranking values.

3.4 Quality Requirements

The complexity of the Web application may be viewed in terms of quality requirements such as usability, functionality, reliability, efficiency and maintainability (Olsina et al., 1999) (figure 1):

3.4.1 Usability

Issues like understandability, learnability, friendliness, operability, playfulness and ethics are vital design factors that Web engineers cannot afford to miss. The system must be implemented in such a way to allow for easy understanding of its functioning and behaviour even by non-expert Internet users. Aesthetics of user-interface, consistency and ease-of-use are attributes of easy-to-learn systems with rapid learning curve.

3.4.2 Functionality

The system must include all the necessary features to accomplish the required task(s). Accuracy, suitability, compliance, interoperability and security are issues that must be investigated in designing an e-commerce system to ensure that the system will perform as it is expected to. The e-commerce application must have searching and retrieving capabilities, navigation and browsing features and application domain-related features (Olsina et al., 1999).

3.4.3 System Reliability

Producing a reliable system involves understanding issues such as fault tolerance, crash frequency, recoverability and maturity. The system must maintain a specified level of performance in case of software faults with the minimum crashes possible. It also must have the ability to re-establish its level of performance. A system must consistently produce the same results, and meet or even exceed users' expectations. The e-commerce application must have correct link recognition, user input validation and recovery mechanisms.

3.4.4 Efficiency

An e-commerce system's goal is usually to increase productivity, decrease costs, or a combination of both. Users expect the system to run in an efficient manner in order to support their goals. System's response-time performance, as well as page and graphics generation speed, must be high enough to satisfy user demands. Fast access to information must be examined also throughout the system's life to ensure that user requirements are continuously met on one hand, and that the system remains competitive and useful on another.

3.4.5 Maintainability

Some crucial features related to maintaining an e-commerce application is its analysability, changeability, stability, and testability. The primary target here is to collect data that will assist designers to conceive the overall system in its best architectural and modular form, from a future maintenance point of view. With the rapid technological changes especially in

the area of Web engineering, as well as the rigorous user requirements for continuous Web site updates, easy system modifications and timeous enhancements, both in content and in the way this content is presented, are also critical success factors for the development and improvement of an e-commerce system.

3.4.6 Action List

The greater the emphasis put on certain quality characteristics the higher the level of complexity is expected to be. This emphasis is dependant on the business goals of the client organization and the type of the e-commerce system adopted according to the categorization of the previous subsection. For example, if the system implements a Web portal then the need for timeous and continuous updates of its content is more critical than in the case of an e-services oriented system which estimates tax payments. Thus the functional part of the former introduces higher complexity to the development process than the corresponding part of the latter, with higher emphasis placed on functionality and maintainability.

The following Action List will assist the analyst to assess the quality requirements desired for the SMEs e-Commerce application and estimate the complexity factors C2,1 – C2,5 in table 2. In order to do these also consider section 3.5 for the ranking values.

1. Assess the emphasis put on Usability and estimate the value of C2,1.
2. Assess the emphasis put on Functionality and estimate the value of C2,2.
3. Assess the emphasis put on System Reliability and estimate the value of C2,3.
4. Assess the emphasis put on Efficiency and estimate the value of C2,4.
5. Assess the emphasis put on Maintainability and estimate the value of C2,5.

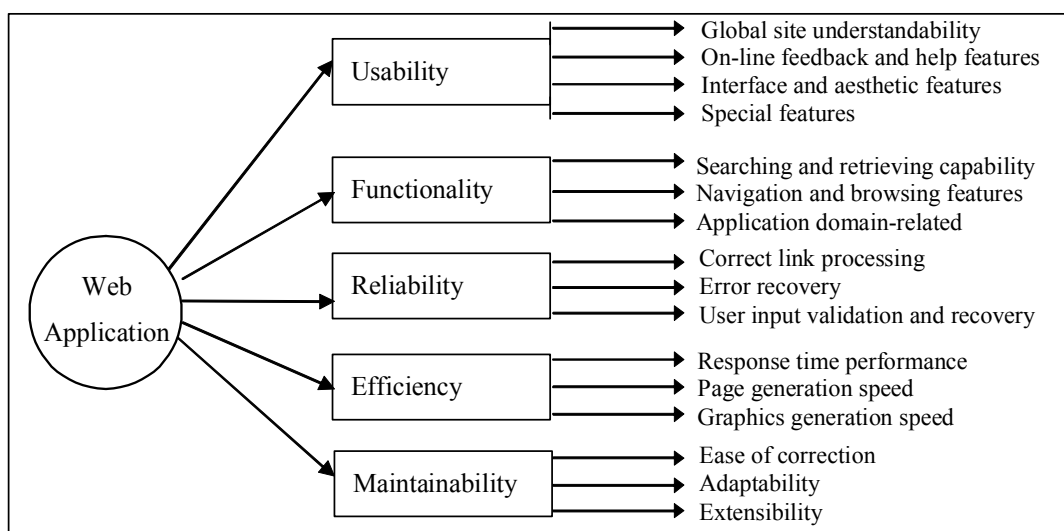


Figure 1 - Quality Requirements Tree for Web Applications (Olsina et al., 1999)

3.5 Critical factors collection and transformation into a measure of development complexity.

The critical factors that belong to each of the three categories mentioned earlier must be identified and examined to realize their contribution to the overall complexity of the e-commerce system. The key information here is related to the first category, that is, the business and organizational issues of the enterprise. As described before, the business and organizational perspective and targets of the organization determine the boundaries of the functional requirements of the system. Thus, the activities of the business and organizational assessment that actually deal with the spectrum of the business issues within the client organization must be conducted in a carefully planned, methodological way. The proposed framework utilizes short-scale ethnography analysis (Macaulay et al., 2000) including on-site observations, interviews and questionnaires. Ethnography analysis aims at revealing hidden requirements, both functional and non-functional, that emerge from the human-social-organizational backbone of the user groups, recording at the same time the rest of the client's needs usually collected through classic, traditional analysis activities. The emphasis on the short form of ethnography analysis is given through predefined focus questions produced in the form of questionnaires. These questionnaires are distributed among the targeted user groups or can be used as part of the interviewing process. The answers to the questions are recorded, analysed and evaluated in order to form the business orientation of the organization, its strategy and business goals. Table 1 provides a sample set of focus questions for the business assessment. It must be noted, however, that this is just a core set of questions, which may be enhanced where appropriate and according to the client organization.

Once the critical business and organizational factors become visible, the developers must collate them to the quality requirements and the application type(s) required to meet the client's business objectives. This is performed using two checklists: The first list contains the quality features and the second the application types. The analyst/developer walks through the list of the business and organizational factors already recorded and checks a quality feature or application type as a required item when a certain factor explicitly or implicitly dictates their incorporation in the system under development. Furthermore, the checking involves adding a numerical value corresponding to the estimation of the level of complexity the specific item introduces to the system. This value scales as follows: 0 (absent), 0.25 (low), 0.5 (medium), 0.75 (high) and 1 (ultimate). The absent value refers only to the case of the application domain where a certain type of application is not among the required functionality of the system. The outcome of this task is a table containing the complexity estimations for each factor in each of the three categories (table 2).

Table 1 - Sample focus questions for the initial business assessment

Business Key Areas	Focus Questions
Business Goals	What is the purpose of the Web application?
	If this is a transaction oriented application, what are the business profit targets?
	How do the stakeholders' views vary (if they do) from the managements'?
	How feasible are the business goals and what is their level of complexity?
Market Aspects	What is the present market competitiveness in e-business?
	What required features are in common with competitors' successful Web applications?
	At what degree does the management wish to compete in the target-market? Is the SME's management determined enough to dominate the target market?
	How effective is the existing system compared to the old? Consider the "pre e-business" SME's business processes toward the new business processes influences by the adoption of the e-business concepts. Will the new way of doing business replace the existing one or will it work as an additional business channel?
Human Resources	Is the management familiar with e-commerce processes?
	Is the staff familiar with Internet and e-commerce transactions?
	Is there an adequately trained personnel for the new processes?
	Who will be maintaining the site? Is he knowledgeable to do so?
	What are the users' feelings in reengineering their current processes?
	What are the users' expectations of the e-commerce system?
	What is the current level of cooperation and communication between individuals?

Table 2 - Complexity estimation based on numerical values assigned to key components and corresponding factors.

Components	Factors	Complexity Estimation
Business Assessment	Business goals	C1,1
	Market aspects	C1,2
	Human resources	C1,3
Quality Requirements	Usability	C2,1
	Functionality	C2,2
	Reliability	C2,3
	Efficiency	C2,4
	Maintainability	C2,5
Application Domain	Informational	C3,1
	Download	C3,2
	Customizable	C3,3
	Interaction	C3,4
	User Input	C3,5
	Transaction oriented	C3,6
	Service oriented	C3,7
	Portal	C3,8
	Database access	C3,9
	Database warehousing	C3,10

The process for estimating the level of complexity is graphically depicted in figure 2. The Web application receives a weight based on the estimated complexity of the factors participating in three components: Business and Organizational Assessment, Application Domain and Quality Requirements.

The complexity estimations of the factors in table 2 (second column) enter the central circle of figure 2 and the average complexity is estimated using the following formula:

$$Av_compl = mean \left(\begin{array}{l} mean(C_{1,i}, i = 1..3) + mean(C_{2,j}, j = 1..5) \\ + mean(C_{3,k}, k = 1..8 \wedge C_{3,k} \neq 0) \end{array} \right)$$

Equation 1

where the Cs are those define in table 2 (third column). The third part of eq.(1) accounts for the zero values of the complexity level set for the irrelevant to the system's services types of application. Thus, only the non-zero values participate in the mean value estimation of this component.

Based on the average level of complexity a short process cycle (SPC – left hand-side of figure 2) or a long process cycle (LPC- right hand-side of figure 2) is decided and followed during development. The suggestion here is to follow the LPC in the case in which the estimated average complexity value is equal or greater than 0.5 (medium), otherwise the SPC is adopted.

It is important to note, however, that the estimation procedure does not take into consideration either which of the three axons has contributed most to the average complexity, or whether a certain case is more complicated than another. It rather concentrates on whether complexity is high enough to dictate the selection of a longer and more tentative development process between the two suggested types (LPC, SPC).

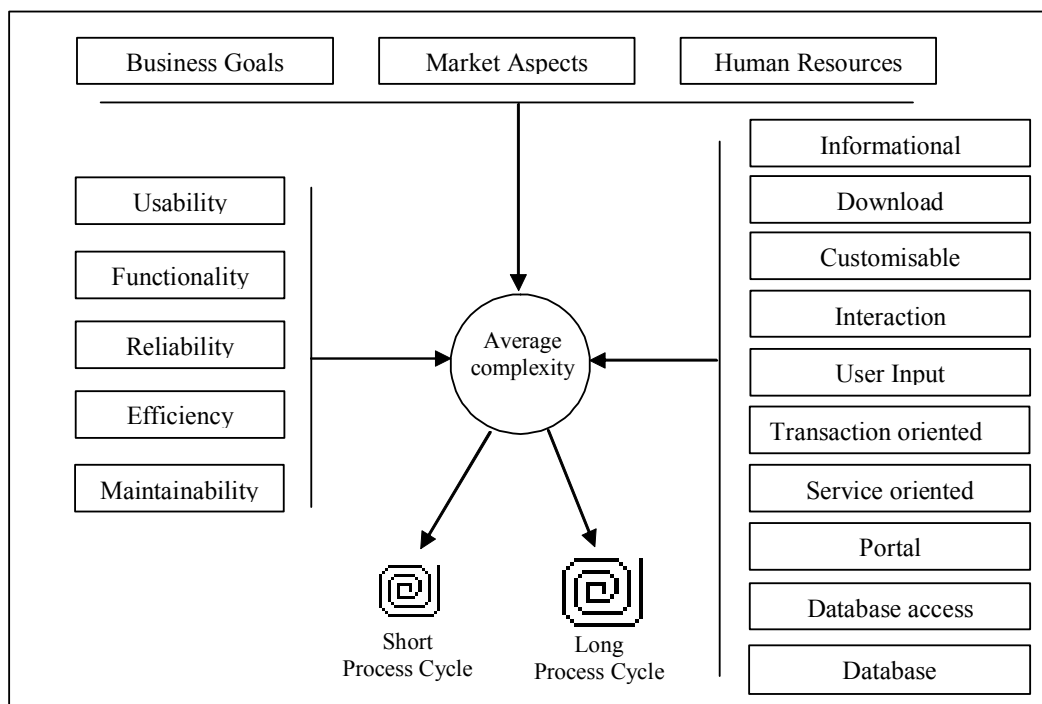


Figure 2 - Combining critical factors to estimate the complexity level of an e-commerce system under development and decide to follow a long or short process cycle

3.6 THE PROPOSED PROCESS MODEL

While there are several software engineering process models, the Spiral model is more appropriate for the development of e-commerce applications (Pressman, 2000). The Spiral model is a cyclic approach that allows development of increasingly detailed elaboration of a software system’s definition, culminating in incremental releases. In each cycle, the basic operations are repeated if necessary and the project is adjusted accordingly. That makes it more suitable in cases where the application technology is rapidly moving, the team composition is changing, there is little user or developer experience and there is a need for

rapid system completion. It provides flexibility and lets the development team adapt to accompanying risks and uncertainties while remaining sufficiently formal to maintain focus on the main milestones. These characteristics of the model make it suitable for e-Commerce applications development and therefore it is used here as the basis of our proposed process model in terms of long and short cycle of activities.

The process model is based on the Web Engineering (WebE) process (Pressman, 2000) (figure 3). The WebE process includes six phases allowing parallel activities development: (a) Formulation, (b) Planning, (c) Analysis, (d) Engineering, (e) Page generation and testing, and (f) Customer evaluation.

The analysis, engineering, and page generation and testing phases of a long process cycle (LPC) include separate activities than those performed when following a short process cycle (SPC). The activities of each cycle are briefly described as follows:

3.6.1 Long Process Cycle

3.6.1.1 Analysis phase activities

1. **Requirements Elicitation** – Gathering of requirements based on the needs of the organization, users and customers. Requirements elicitation can be performed by a variety of methods such as, questionnaires, interviews, observation, document collection, and participative methods (e.g. focus groups) (Smith, 1997).
2. **Requirements Analysis** – Categorization and organization of requirements into related subsets, the exploration of each requirement in relationship to others, the examination for consistency, omissions and ambiguity, and the ranking of requirements according to the customers' and users' needs.
3. **Risk Analysis** – Identification, understanding and management of uncertainty, as well as the estimation of its impact and the establishment of a contingency plan in case a problem occurs.
4. **Requirements Definition** – Translation of information gathered by the previous activities into a document that clearly defines a set of requirements.
5. **Requirements Specification** – Detailed description of the system requirements to serve as the foundation for the system development. A standard template can also be developed for the presentation of consistent requirements (Sommerville and Sawyer, 1997).
6. **System Modelling** – Development of a system model representing input, process and control functions, output, user interface processing and self-test processing (Hatley and Pirbhaj, 1987).

7. **Requirements Validation** – Examination of the Requirements Specification to ensure that all functional and non-functional requirements identified conform to the standards established for the process, the project, and the product.
8. **Requirements Management** – The identification, controlling and tracking of requirements' changes as the project proceeds.

3.6.1.2 Engineering phase activities

1. **Architectural Design** – Mapping of requirements into a Web system architecture representing the structure of data and program components.
2. **Navigation Design** – Design of navigation pathways to enable users to access the Web application content and services by identifying navigation semantics of each user group and by defining the mechanics of achieving the navigation.
3. **Interface Design** – Development of a screen layout to serve as an effective communication medium prototype between the user and the system.
4. **Content Design** – Design of the Web application content, which includes text, graphics, images, video and audio data.
5. **Production** – Development of the Web application based on the information and designs gathered during the previous activities.

3.6.1.3 Page generation and testing phase activities

1. **Page Generation** – Installation of the Web application and the integration into the current system (if available), as well as the adaptation to the existing working procedures.
2. **Testing** – Testing of individual modules as well as of the Web application as a whole employing black-box and testing-to-code techniques.
3. **Training** – Demonstration and training of the system to the management and the users, and creation of a user online tutorial, a reference guide and a maintenance manual.

3.6.2 Short Process Cycle

3.6.2.1 Analysis phase activities:

1. **Requirements Elicitation** – Elicitation process of requirements performed by short-length methods such as interviews and document collection.
2. **Requirements Analysis** – Categorization of requirements and their importance based on the needs of customers and users.

3. **Requirements Definition** – Translation of information gathered by the previous activities into a document that defines a set of requirements and serves as an agreement document between the management and the designer.

3.6.2.2 Engineering phase activities

1. **Architectural and Navigation Design** – Abstract mapping of requirements and navigation pathways into a Web system architecture.
2. **Interface/Content Design and Production** – Rapid prototype development of the interface and evolution of this prototype into the final application with content production and incorporation.

3.6.2.3 Page generation and testing phase activities

1. **Page Generation and Testing** – Installation of the Web application and its testing utilizing black-box methods.
2. **Training** – Short demonstration and training of the system to the management and the users.

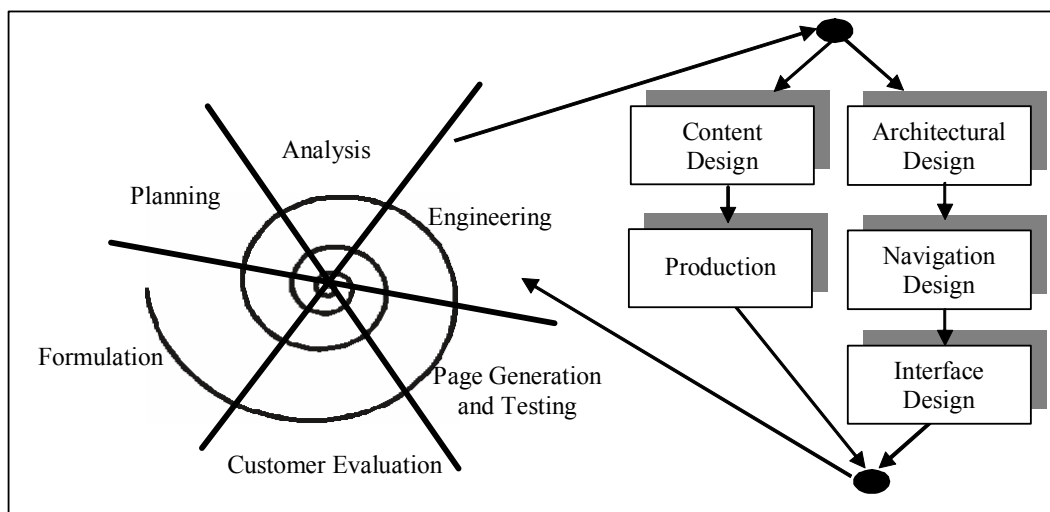


Figure 3 - The WebE Process Model

4. Implementing the web engineering methodology

4.1 Overview

Companies often want to reengineer their business environment into an e-business one without first having an appropriate plan in place to methodically guide them through to a successful reengineering.

Furthermore, each company may have unique needs and requirements in the e-business world. Based on the resources each company may have, they may need a different amount of effort to be transformed to e-business. Factors such as economical and technological could affect the reengineering process.

The web engineering methodology analysed in this deliverable goes over a range of factors that are considered critical for the success of the reengineering process and provides a general approach in deciding whether an SME should follow Short Process Cycle (SPC) or Long Process Cycle (LPC) for the development cycle process of its web application. In this way, an SME has clear guidelines as to which steps it should follow to efficiently and effectively design its e-environment.

4.2 Implementation

As we mentioned earlier, the methodology uses a general approach to transform the business environment towards an e-business one. The openness of the methodology is essential so that it could be used and implemented without any limitations. Each region could implement the methodology based on its specific needs and requirements. According to the situation, various approaches can be used to implement the methodology such as interviews, questionnaires, videotaping and other in an attempt to gather the needed information.

4.2.1 Cyprus implementation

Cyprus' case concerns the evaluation of SMEs who wish to go on-line through the Leveraging Center (LC). At first, SMEs should perform a feasibility study to find out if the business' transformation to e-business is practicable and profitable. Then a risk analysis should be performed to identify the risks associate with the business' reengineering process along the impacts that may affect the normal operation of the business. After performing these two studies, we should evaluate the overall business environment to make sure that there is the appropriate background (technological, economical, human resources) and that reengineering the business environment into an e-business is practically applicable.

5. Before taking any actions towards the transformation, it is essential to estimate which development cycle (short or long) a business should follow to design and implement its web application. Cyprus considers that the most efficient way to gather the necessary information is through the questionnaire found in Bibliography

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Appendix I - Web Engineering Methodology Questionnaire (based on the proposed methodology). The way of thinking in designing the questionnaire is simple; the methodology is consisted of three categories related to critical factors that concern the business environment. Therefore, the questionnaire was developed based on these three categories:

5.1.1.1 Business and Organizational issues

The questions included in this category aim in identifying the current business state of the organization and the need for reorganize the business environment. This category is further separated into three subcategories so that key issues could be identified: Business goals, Market aspects and Human resources. Each question is followed by a scale table which evaluates the issue discussed in terms of system's complexity. The scale tables are used to estimate the mean complexity of the Business and Organizational issues category included in the formula for computing the average complexity of the system (see below). After answering the questions and completing the tables, the mean complexity is estimated for the three subcategories mentioned above using the following Equation 2

$$C_{1,j} = \frac{\sum_i Q_i}{i}$$

Equation 2

Where Q stands for the question, $i=1..n$ and n is the number of questions in business goals category and j represents business goals, market aspects and human resources categories.

5.1.1.2 Application domain aspects and Quality requirements

In order to compute the mean complexity for the rest of the categories, we combined them into one table. Application domain aspects involve the type(s) of the web application and quality requirements refer to quality factors that the application should have.

First, we identify the types of the web application (informational, download, customisable, interaction, user input, transaction oriented, service oriented, portal, database access and database warehousing) and the complexity needed to implement each type. Then, for each type identified we estimate the complexity each quality requirement (usability, functionality, reliability, efficiency and maintainability) introduces to the application.

Estimating the complexity of each type of web application is easy; it is the complexity identified in the table. The complexity of each quality requirement is more complicated to compute as each requirement is linked with every possible type of web application. Therefore the complexity of each quality requirement is estimated among the identified type(s) of web application using the following formula:

For each type of web application we normalize the complexity as follows.

$$\hat{C}_{3,i} = C_{3,i} / \sum_j C_{3,j}$$

Equation 3

Where i,j is the web application types

To estimate the complexity of each quality requirement we use the following formula. The basic idea is to put the normalized values of each web application type as the weight for the contribution of the quality requirement of each type.

$$C_{2,i} = \sum_j (C_{2,i} * \hat{C}_{3,j})$$

Equation 4

Where i stands for the quality requirement and j stands for the web application type.

5.1.1.3 Computing the average complexity

After estimating the complexity values for each category mentioned above, we fill

Table 2. At the end, the average level of complexity is estimated using Equation 1 and the values we computed to decide which cycle the business should follow during development.

5.1.1.4 Demonstration of the proposed methodology in Cyprus

In this section we will present the implementation of the methodology as it was implemented to the following four SMEs. The first two SMEs (Tsaousis and Top Kinisis) were used to prove the correction of the methodology as they are already online. We applied the methodology and we verified that the process cycle they followed is the same one with the cycle that the methodology detected. The other two SMEs are “traditional” enterprises that wanted to go e-enabled. Therefore the methodology was used to decide whether they are going to follow Short Process Cycle (SPC) or Long Process Cycle (LPC) for the development cycle process of their web application.

5.1.1.4.1 Tsaousis One Million

5.1.1.4.1.1 *Company Profile*

Tsaousis 1 Million offers a large variety of non-food consumer products both in retail and wholesales level. The company was established decades ago, in Cyprus and it started with one single shop in Nicosia. It is considered to be a family business since management passes from father to son. It is considered to be the only large company in Cyprus, which offers such a great variety of products. Many of those products are especially imported for this company. Tsaousis 1 Million has a very reputable name in the country’s market and it has been a synonym for the vast product ledger at least within the capital city. Tsaousis 1 Million sells its products either through retail, it owns 3 large stores, or through wholesalers all over the island. These are the traditional channels used to communicate and contact its customers. In the case of Tsaousis 1 Million, e-commerce and generally e-business could be another channel both for the company’s retail customers (Business to Customer channel) and also a channel to other partners and associates, for example the wholesalers (Business to Business channel). Therefore Tsaousis 1 Million’s management thinks of e-business as an opportunity for the company for further business development. The management’s belief is that eventually e-commerce is going to become the new form of commerce and that the new digital economy will be based on e-commerce. In order to be ready for that opportunity, Tsaousis 1 Million has already made steps into e-commerce and the management believes that the company is more or less ready for the new era of electronic economy. Their plan is to take advantage of the great opportunity that e-business presents and become a leader in introducing e-commerce in their market. The company imports 90% of their products and its market is 60% in the

retail sales and an unbelievable percentage of 40% in wholesale. There are not really direct competitors to them since there are not other companies in the same business in the country. The advantage of Tsaousis 1 Million is the really impressive variety of goods that offers and its well-known name.

5.1.1.4.1.2 Feasibility Study – Key issues identified

The company's main focus is to offer to their customers another channel of product distribution through Internet. They "own" the customers, they have relationships with them and now they are going to offer them a new utility, their e-Shop. It will be very useful for them to include in their business practices a good customer relationship management, this will personalize the company's relationship with their customers and it will improve the interaction between the company and the customer.

Apart from the above the management aims to enlarge the e-business utilization and implement business-to-business operations in the future. The management is also considering implementing an Intranet and porting more of the company's internal applications in this Intranet.

Another ring in the e-commerce chain is the distribution and the delivery of the goods to the customer. The company has made enough provisioning about this by making an agreement with a local courier company for the product delivery. The customer pays for the delivery for small buys otherwise he is entitled free delivery. The delivery company has also the responsibility to collect the money for the purchase upon delivery. Of course there is always the credit card option but unfortunately the local credit card clearing house (the only one in the country) does not offer (until now) the ability to make online credit card transactions.

The company had invested significant efforts and resources in the e-commerce perspective business. The investment consists of the e-commerce portal platform hardware and software, the recurring fees of the platforms connectivity to the Internet, and the recurring maintenance costs of the platform. They have designed business processes and structures in order to enable e-commerce and they allocated human resources in order to update the portal and take care of the sales through the Internet.

5.1.1.4.1.3 Risks Identified

The estimated risk for this initiative is considered to be low because of the way that Tsaousis 1 Million views the e-business opportunity. The firm sees e-business as another channel of doing business and through this it is targeting customers that it is impossible to have. If you consider that e-commerce is not very well known in the country, the pioneers will benefit and

since the running costs of the e-commerce portal are fairly low the risk is estimated low. The reaction of the customers is considered to be unpredictable although there are indications that people are keen on this kind of innovations.

There is evidence that the public's reaction will not be positive due to the small volumes of the other e-commerce portals, which are not considered to be successful business cases. In that case, the portal can act as a complement to the other firm's channels of sales.

The management believes that the key to the success of this electronic shop project will be a campaign in order to advertise it and inform the public and the customers for its existence and the services been offered by this portal. Steps towards integration with other systems, especially invoicing, stock control and accounting should be made. The opportunity of adding new features to the existing system should be exploited. New products and new services and alliances with associates and partners e.g. delivery should be considered in order to attract more customers.

5.1.1.4.1.4 Business reengineering assessment

As it is mentioned earlier, Cyprus considers the development of a detailed questionnaire as the best way to implement the proposed methodology. Cyprus believes that through the questionnaire we could gather the necessary information to describe the business environment within Cyprus. For this reason, the questionnaire was given to two executives representing Tsaousis and Top Kinisis respectively, who had the knowledge to provide information. In addition, each company performed its own market and business studies where needed to determine various market aspects such as competitiveness and customers' experience.

After the completion of each questionnaire, Cyprus team analysed the responses and calculated the mean complexity based on the ratings that were given by the executives. The calculated complexity determined the cycle (short or long) that each company has to follow to reengineer its business environment.

5.1.1.4.1.4.1 The Questionnaire

This section contains the answered questionnaire regarding Tsaousis case study. Based on the answers and ratings we will calculate the average complexity, found in the next section.

1 Business and Organizational issues

Business and Organizational issues attempt to assess the current state of the SME; the assessment is focused on business processes and organizational issues and aims in explaining the need for change, and illustrating the desired position the SME aspires to capture via the e-commerce system. This process can reveal critical factors about the SME's organization and

the business operations performed that orient the answer to the question whether the organization is ready to move to e-commerce and give indications as regards the level of the development effort needed for building a new or modifying an existing system.

Emphasis should be given on three key areas:

1.1 Business Goals

The responsibility of the analyst towards the business goals of the SME is to discover the business goals as they are defined by the management and evaluate them against the development complexity introduced into the system.

Q.1.1.1 What are the SMEs business goals in terms of extendibility, profit/budget and time limitations?

The SME wants to expand its sales and in the same time to cut operational costs. The whole project is identified as a high risk therefore the budget for it is going to be low and the profit expectations are high. Time is not so critical because there is not established competition.

In the case where business processes are transformed in a way that they fit better to an e-business oriented environment (i.e. transform delivery/order service) what is the complexity introduced into the system? Please consider budget, expected revenue, time and effort limitations in order to assess the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.2 Is the management supportive in transforming the business to e-business? If the answer is yes, complexity could be low.

The management initiated the project so everybody is expecting all its management and attention as long as the project meets its targets (profit, budget, time).

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.1.3 What will be the purpose of the developed web application?

The purpose of the proposed web application is to implement an electronic sales outlet for the SMEs products.

How complex is to achieve the application's purpose? i.e. in the case where the application serves informational reasons, the complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.4 What is SME's target audience? Do they have any e- experience?

The target audience is every consumer who know how to browse in the internet and he/she is willing to buy online. We cannot know if every consumer has e-experience, intuitively we know from market researches that around 5% of the population uses e-commerce. For this reason the complexity should be Ultimate.

Based on the customers' knowledge and experience what is the complexity introduced into the system? i.e. if they are experienced complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

Q.1.1.5 Which (current) business processes the SME would like to extend?

There are no business processes to extend, so the SME is preparing new business processes for the e-commerce environment.

How complex is to extend these business processes?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.1.6 Does the SME have the resources to accomplish it in terms of human resources?
Please explain.

The SME has not the suitable H.R. to accomplish the project so the management decided to outsource most of the work (mainly the technical part).

Having in mind your human resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.1.7 Does the SME have the resources to accomplish it in terms of technical resources?
Please explain.

The same as Q.1.1.6.

Having in mind your technical resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.1.8 Does the SME have the resources to accomplish it in terms of budget resources?
Please explain.

The demanded budget is very low so this is not a very important issue for the company. The project does not demand funding form outside the company.

Having in mind your budget resources, how complex is to achieve extendibility?				
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Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.9 What is SME’s estimation about the complexity of re-engineering the business to transform it to e-business in terms of technical limitations?

The SME is not going to perform this kind of transformation. It going to keep its current business processes and it is going to create new ones for the e-business part.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.1.10 What is SME’s estimation about the complexity of re-engineering the business to transform it to e-business in terms of budget limitations?

The same as Q.1.1.9. Budget limitations do not apply here.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.1.11 What is SME’s estimation about the complexity of re-engineering the business to transform it to e-business in terms of time limitations?

The same as Q1.1.9. Time limitations do not apply here.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

1.2 Market Aspects

This section aims in assessing various market aspects as competitiveness and customers’ expectations, and how these issues could affect the development of the ecommerce application. Therefore, the analyst should be informed on both market and SME environment.

Q.1.2.1 What is the present market competitiveness that the SME would have to face in the specific field it is occupied?

The market is not competitive at all right now. There is one or two players in it but the have (together) just a tiny portion of the market. The company will have to create clever and convenient processes of doing business with its customers in order to implement a productive and prosperous distribution channel through the Internet.

In what degree competitiveness could affect the complexity of the system? i.e. if competition is high, complexity could be high too.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.2 At what degree does the management wish to compete in the target-market? Is the SME's management determined enough to dominate the target market? i.e. if the SME wishes to offer low-cost services to compete with other enterprises offering similar services it should have to find ways lowering internal costs, therefore introducing a higher complexity into the system.

Since there is not serious competition right now the management want to dominate the market. The management thinks that this will be easy for them because of the competitions absence. The critical factor will be the quality and efficiency of their services.

Based on the management's decision, what is the complexity introduced into the system? i.e. if the management expects to compete in a high scale then complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.2.3 Based on the SME's needs and expectations, do they require developing a more complex web application (include other innovating features/services)?

There is not a requirement to develop a complex web application. They feel that a standard commercial e-commerce application will be good for them.

Based on your response, what is the complexity introduced into the system? i.e. if your response is positive, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.4 How effective is the existing system compared to the old? Consider the "pre e-business" SME's business processes toward the new business processes influences by the adoption of the e-business concepts. Will the new way of doing business replace the existing one or will it work as an additional business channel?

Since the e-commerce system is going to be separated from the traditional way of doing business and the two of them are going to operate in parallel, one can not give answer to this question.

What is the complexity introduced into the system when one of the case is valid?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.2.5 What required features/services are successfully implemented and widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

Currently there is only one competitor and since the web application required is more or less standard there is no need for special features.

What is the complexity introduced into the system to acquire these features/services? Having in mind that these features/services (i.e. payment gateways) are already implemented, complexity could be low if the features can easily be accessed by you.				
Absent (0)	Low (0.25)	Medium	High (0.75)	Ultimate

		(0.5)		(1)
	X			

Q.1.2.6 What required features/services are not widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

There are no features/services that are not widely used by others in the same or similar business market

What is the complexity introduced into the system to implement these features? Having in mind that these features may not be already implemented, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.2.7 What is SME's estimation about the upper time bounds needed to complete the transformation to e-business? Is there any possibility for the demands of the marketplace to shift over until the transformation is finished?

As far as this SME there is not going to be a transformation to e-business. However the e-commerce applications needs to be launched quickly in order to be in front of the expected future competition.

Based on the time limits set by SME or the marketplace, what is the complexity introduced? Note that the smaller the time frame the higher the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

1.3 Human Resources

A vital component for the success of the e-commerce application is the human resources. This is due to the fact that complexity is introduced into the system, accordingly to employees and management behaviour and expertise.

Q.1.3.1 Is the management familiar with e-business processes?

Yes, in a degree.

Based on the management's familiarity with e-business processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.3.2 Are the employees familiar with Internet and e-commerce transactions?

The great majority of them is not familiar with Internet and e-commerce transactions.

Based on the employees' familiarity with internet and e-commerce transactions, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.3 Is there an adequately trained personnel for the new processes?

No but there will be.

Based on the personnel's training for the new processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.4 Who will be maintaining the site? Is he/she knowledgeable to do so? If the answer is yes, complexity could be low.

The maintenance has been outsourced.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.3.5 What are the employees' feelings in re-engineering their current processes?

The new environment is not going to influence, at least direct, their current process.

Based on the employees' feelings in re-engineering their current processes, what is the complexity introduced into the system? i.e. if they have positive feelings, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.6 What are the customers' expectations of the e-commerce system?

The customer's opinion is not know yet. The SME is preparing an advertising campaign and then they are going to do a market research in order to learn the customer's opinion.

Based on the customers' expectations, what is the complexity introduced into the system? i.e. if they have high expectations, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.7 What is the current level of cooperation and communication within the SME environment (i.e. employees, management)?

It can be described with the words very good, not excellent or pure.

Based on the level of cooperation and communication between within the SME environment, what is the complexity introduced into the system? i.e. if communication is in line, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

2 + 3. Application domain aspects and Quality Requirements

The categorization of the various types of Web applications assists in estimating their level of complexity and the development effort required.

Please identify which of the following types of web applications apply to your application and estimate the effort and complexity needed to implements each type (it could be more than one). In addition, please list the emphasis you place on each quality requirement which applies into your application.

Types of Web Application	Please choose					Quality Requirements	Please choose				
	0	0.25	0.5	0.75	1		0	0.25	0.5	0.75	1
<i>Informational</i> Read-only content with navigation and links.		X				Usability					X
						Functionality					X
						Reliability				X	
						Efficiency				X	
						Maintainability				X	
<i>Download</i> Information available for downloading by the user.	X					Usability	X				
						Functionality	X				
						Reliability	X				
						Efficiency	X				
						Maintainability	X				
<i>Customizable</i> Content can be customized based on user needs.	X					Usability	X				
						Functionality	X				
						Reliability	X				
						Efficiency	X				
						Maintainability	X				
<i>Interaction</i> Communication among users via chat rooms, bulletin boards, or instant messaging.			X			Usability		X			
						Functionality			X		
						Reliability		X			
						Efficiency				X	
						Maintainability			X		
<i>User input</i> Communication via online forms.		X				Usability			X		
						Functionality			X		
						Reliability		X			
						Efficiency				X	
						Maintainability	X				
<i>Transaction oriented</i> Order processing					X	Usability				X	
						Functionality				X	

(products and services).					Reliability					X
					Efficiency				X	
					Maintainability		X			
<i>Service oriented</i> The application provides an online service (e.g. estimating a mortgage payment).		X			Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency			X		
					Maintainability	X				
<i>Portal</i> A starting point that channels the user to other Web applications outside the domain of the portal application.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Database access</i> Querying a database and retrieving information.		X			Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency			X		
					Maintainability	X				
<i>Data warehousing</i> Querying a collection of large databases and retrieving information.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				

5.1.1.4.1.4.2 Analysis

The analysis and the calculation of the mean complexity are based on the proposed formulas described in section 4.2.1 Cyprus implementation.

The first part of the questionnaire is the “Business and Organizational Issues”, which is subdivided into three key areas: Business goals, Market aspects and Human resources. The formula corresponding to the first part of the questionnaire is the following:

$$C_{1,j} = \frac{\sum Q_i}{i}$$

Having in mind the rating given in the questionnaire we are going to calculate the complexity associated with Business goals, Market aspects and Human resources sections respectively. We first start with the Business Goals section. The following values are taken from the questionnaire and correspond sequentially to the rating given: 0.75, 0, 0.75, 1, 0, 0, 0, 0.25, 0, 0, 0. To apply the formula, we first need to add all the values and then divide by their plurality. Therefore, $C_{1,1} = 2.75/11 = 0.25$.

Tsaousis has a clear picture of what they expect to do to implement e-business into the local business environment.. Due to the fact that the necessary personnel is missing, the management decided to outsource most of the work. In addition, this SME does not estimate

to transform the existing business environment rather than designing and creating new e-business processes. Therefore the complexity of the Business goals is low, 0.25.

The values corresponding to Market aspects are: 0.25, 0.5, 0.25, 0, 0.25, 0, 0.25. With the same formula as used previously we calculate the complexity $C_{1,2} = 1.5/7 = 0.214$.

As we observe, the complexity of the market aspects is also low, 0.214. The reason is mainly that there isn't any major competition in the Cypriot market by other players and that the SME wants to design a standard commercial eCommerce application which does not introduce any extra overhead to the complexity for implementing the new system.

Last area is Human resources and the associated values are: 0, 0.25, 0.25, 0, 0.25, 0.25, 0.5. By applying the same formula as before we have the following result $C_{1,3} = 1.5/7 = 0.214$.

As we mentioned earlier, most of the work will be outsourced due to the fact that the human resources of the SME are not adequate. Also, existing personnel will need training on the new processes but this is not considered an obstacle at all. That is the reason for the complexity value to be so low, 0.214.

Therefore, the mean complexity value for the Business and Organizational Issues is the following: Mean complexity (BandOI) = $(0.25 + 0.214 + 0.214)/3 = 0.226$.

We continue our calculations by computing the mean complexity for the rest of the categories included in the questionnaire. First, we need to analyse Application domain ratings and then Quality requirements ratings.

The values associates with the Application domain are as follows: Informational $C_{3,1}=0.25$, Download $C_{3,2}=0$, Customizable $C_{3,3}=0$, Interaction $C_{3,4}=0.5$, User Input $C_{3,5}=0.25$, Transaction oriented $C_{3,6}=1$, Service oriented $C_{3,7}=0.25$, Portal $C_{3,8}=0$, Database access $C_{3,9}=0.25$, Database warehousing $C_{3,10}=0$. The average complexity for this area is associated only with the non-zero values; therefore Mean Complexity (Application domain) = $2.5/6 = 0.416$.

Tsaousis estimates that customers will approach its website for gathering information on specific items where they could access the company's database to retrieve information or they could use other online services provided on the web site. So far the complexity is estimated to be low due to the simplicity of the processes. Complexity is significantly increased for interacting with the system and transacting online. This SME considers creating contact channels with the customers a very significant element for the success of the company. In addition, Tsaousis requires building trust relationships with the customers so that they will be confident for the security provided by the company and transact online. That is why the overall complexity introduced into the system by the application domain is increased to 0.416. The calculation of the Quality Requirements section is a bit more complex than the other sections as we first have to normalize the complexity for each Application domain which is

associated with specific quality requirements in order use the normalized value as weight to computed the weighted average of each quality requirements .

We use the following formula which normalizes the averages of each application domain (we divide the specified application domain complexity with the summation of all the application domain complexity values):

$$\hat{C}_{3,i} = C_{3,i} / \sum_j C_{3,j}$$

Where i,j is the web application types

Informational $\hat{C}_{3,1} = 0.25/2.5 = 0.1$	Download $\hat{C}_{3,2} = 0/2.5 = 0$
Customisable $\hat{C}_{3,3} = 0/2.5 = 0$	Interaction $\hat{C}_{3,4} = 0.5/2.5 = 0.2$
User Input $\hat{C}_{3,5} = 0.25/2.5 = 0.1$	Transaction oriented $\hat{C}_{3,6} = 1/2.5 = 0.4$
Service oriented $\hat{C}_{3,7} = 0.25/2.5 = 0.1$	Portal $\hat{C}_{3,8} = 0/2.5 = 0$
Database access $\hat{C}_{3,9} = 0.25/2.5 = 0.1$	Database warehousing $\hat{C}_{3,10} = 0/2.5 = 0$

To estimate the complexity of each quality requirement we use the following formula. The basic idea is to put the normalized values of each web application type as the weight for the contribution of the quality requirement of each type.

$$C_{2,i} = \sum_j (C_{2,i} * \hat{C}_{3,j})$$

Where i stands for the quality requirement and j stands for the web application type.

- Usability $C_{2,1} = 1*0.1 + 0.25*0.2 + 0.5*0.1 + 0.75*0.4 = 0.5$
- Functionality $C_{2,2} = 1*0.1 + 0.5*0.2 + 0.5*0.1 + 0.75*0.4 = 0.55$
- Reliability $C_{2,3} = 0.75*0.1 + 0.25*0.2 + 0.25*0.1 + 1*0.4 = 0.55$
- Efficiency $C_{2,4} = 0.75*0.1 + 0.75*0.2 + 0.75*0.1 + 0.75*0.4 + 0.5*0.1 + 0.5*0.1 = 0.7$
- Maintainability $C_{2,5} = 0.75*0.1 + 0.5*0.2 + 0.25*0.4 = 0.275$
- The Mean complexity (Quality requirements) = $2.575/5 = 0.515$.

The quality requirements score a higher complexity also. In general, Tsaoasis requires usability so that people with no e-experience could easily use its website; functionality is required to serve expectation of all potential customers. Considerations are also made for reliability, efficiency and maintainability issues as an error-free system that quickly processes requests is a necessity for a successful ecommerce application.

The table bellow shows a summary of the values as they were computed in the previous section. Using the values above we will now compute the average complexity.'

Table 3 - Tsaousis Analysis

Components	Factors	
Business Assessment	Business goals	0,25
	Market aspects	0,214
	Human resources	0,214
Mean		0,226
Quality Requirements	Usability	0,5
	Functionality	0,55
	Reliability	0,55
	Efficiency	0,7
	Maintainability	0,275
Mean		0,515
Application Domain	Informational	0,25
	Download	0
	Customisable	0
	Interaction	0,5
	User Input	0,25
	Transaction oriented	1
	Service oriented	0,235
	Portal	0
	Database access	0,25
	Database warehousing	0
Mean		0,416

$$Av_compl = mean \left(\begin{array}{l} mean(C_{1,i}, i = 1..3) + mean(C_{2,j}, j = 1..5) \\ + mean(C_{3,k}, k = 1..8 \wedge C_{3,k} \neq 0) \end{array} \right)$$

Therefore,

$$Av_compl = (0.266 + 0.515 + 0.416) / 3 = 0.399$$

where the result is below 0.5 and short path cycle should be followed.

Appendix II – Complexity Calculations shows an excel file that was used for the calculations.

5.1.1.4.1.5 Conclusions

The company's strategic targets and goals remain the same as before; that is they want to be able to offer a large variety of consumer products and to have their customers to do all their consumer goods shopping at Tsaousis 1 Million. The large variety of goods on offer has become Tsaousis 1 Million's symbol and their promotion advertising is emphasizing this as their major advantage. At the same time, Tsaousis 1 Million wants to offer quality products at low prices so it has to cut prices. This is done in order to be able to beat the competitor's cheap but low quality products. In order to cut costs they have to increase the bargaining power they have with their supplier so they can buy products in lower prices, at least lower

than the competition. They are also trying to offer to the market products that the competition is not aware of, so that they will have the advantage of offering the product first to their customers. Another thing they are doing is to reorganize the way they use their resources, especially human resources, in a more efficient and productive way and to reengineer the business processes in order to simplify and to automate as much as they can their interaction with customers and associate.

5.1.1.4.2 Top Kinisis

5.1.1.4.2.1 *Company Profile*

Top Kinisis is one of the largest companies in the travel industry of Cyprus. The creation of Top Kinisis was the result of a merger between the two large enterprises, Kinisis Travel and Tours established in 1987 and Top Ten Tours established in 1988, which have dominated the travel industry for years. In 1999, they merged in order to create a stronger organization, which could successfully compete with bigger firms in the European and international market. Later on the company acquired partially or fully other smaller travel and tourist enterprises. Most recently Top Kinisis partially acquired a tourism company in Greece, which is specializing in offering holiday packages. This shows that the company's plan is to expand its activities outside Cyprus. Top Kinisis has branches in almost all towns of Cyprus and its associates or partners therefore represent it in all towns. Top Kinisis employs 83 people either as executives or clerical staff. The company's primary channels of distribution of its products and services are its points of presence in all towns and the associates. This traditional approach has worked so far for all players in the tourism and travel industry, so there has been no need for changes regarding the distribution of products and services. In 2000 Top Kinisis was listed in the Cyprus Stock Exchange.

Top Kinisis's activities can be found in almost every area of the travel industry. These activities are Ticketing, Outgoing tourism, Incoming tourism, Cruises, Representation of airline companies (Aviation), Organization of conferences and athletic events, International shipping, Freight forwarding, Cargo logistics, Travel and marine insurance.

Top Kinisis provides travel and tourist services in general and its list of customers is not restricted only in the country. Until now the company had, to approach and contact these customers through the traditional channels, such as direct to customer sales and travel agents. E-commerce and generally e-business could become another channel for Top Kinisis not only for approaching its customers (Business to Customer channel) but also a channel to contact other partners and associates (Business to Business channel). Therefore, Top Kinisis's management thinks of e-business as an opportunity for the company for further business

development. The management's vision is to create, within the company the necessary structures and processes in order to enable the company to take advantage of the great opportunity presented by the adoption of e-business and become a leader in introducing e-commerce in the travel industry of Cyprus.

The company's sales in 2001, were at 19.710.243 CYP (11.660.647 CYP in 2000) and the total profits before taxation were 123.173 CYP (240.689 CYP in 2000). The mismatch was due to increased managerial expenses in 2001 (1.166.479 CYP in 2001 and 501.424 CYP in 2000) although the cost of sales was increased from 2000 to 2001 by almost 50.000 CYP (249.631 CYP in 2001, 203.455 CYP in 2000). Their profit from business was also decreased in 2001 in comparison with that in 2000 (234.088 CYP in 2001, 324.419 CYP in 2000). The board of directors claims that the increase of the total sales and of the managerial expenses is mainly due to the activities of the acquired businesses in the first 6 months of 2001.

5.1.1.4.2.2 Feasibility Study – Key issues identified

Top Kinisis primary target is to dominate the local travel market, and in general to expand its business. Considerations are made and appropriate provisions are taken in order to cut operational costs and use its resources in a more efficient and productive way. Emphasis is given in interacting with customers, therefore the need to reengineer the business's processes in order to simplify the interaction with the system. The management supports the creation of a e-business strategy that will be in-line with the business strategy. The management has already made plans for the company's e-business future. They have gone into strategic alliances with companies, which have a ready-made platform for travel agency companies. The idea is to be able to sell most of their products and services to end customers and business associates, through this system. The system will also collect payments and interface with other systems (e.g. ticketing) in order to be able to reserve and deliver the services and the products. The company is now in the process of creating and interfacing this system with the existing systems.

In terms of IT infrastructure, Top Kinisis has impressive things to demonstrate. They interconnect all their branches with permanent leased lines and they are using a big number of computer applications. Apart from the classic back office applications, such as accounting and payroll, they are using many specific applications for their operations. Systems, like ticketing, incoming, outgoing and aviation, are widely used. These systems communicate with their partners' systems, for example airline ticketing systems, and they also interface with the company's accounting and invoicing system.

The way that the company's management has defined its targets and strategies helps to be flexible and adopt more than one of the e-business models. The company can implement the direct to customer model and have their products and services available to the public and associates via an electronic portal. The company's goal is to be able to serve their customers and associates through a system that will be accessible to everyone. This will make their job easier, more effective and more profitable since they will minimize mistakes, automate the business processes decrease to the nil the human interaction and become able to collect payments efficiently. In other words they are not going to develop e-business as another channel of products and services distribution but as the evolution of their business.

In the same time the management is planning to lead the company to become an enterprise that is its operations are "governed" by an "electronic brain" the whole enterprise model. The management is aiming to import heavy Information Technology utilization into the company. For this reason they made strategic alliances with a local Information Technology company which is going to help them achieve their goal. The implementation of this project is considered to be very important and for this reason the management does not dispose any other information. In fact no one of these models fully captures the company's ultimate goal. If one would like to summarize the previous findings, it would be safe to say that apart from the direct to customer model the company's management is trying to design and implement something close to the whole enterprise model.

5.1.1.4.2.3 Risks Identified

Top Kinisis's initiative is assessed, by the company's people and their partners, as very suitable and appropriate in terms of business strategy. It will be an innovation since Top Kinisis is going to be ahead of the competition and this innovation will be a significant strategic advantage. On the other hand they will manage to reengineer their business's process and structures and to cutback old and time-consuming processes that are a waste of time and resources. This initiative will increase the organization's reputability and will enlarge their capabilities since they will be able to handle more jobs. It will also reinforce the company's position in the market.

The estimated risk for this initiative is fairly high if one considers that it will be an innovation for the country and the market. The reaction of the customers and the business associates is considered to be unpredictable, although there are indications that people are keen on this kind of innovations. However there are some other positive aspects of this transformation into a company that will be able to offer its services both the traditional way and electronically. Top Kinisis's major target is not to attract other customers to its travel portal but to simplify

and enhance the processes of doing business and the interaction with the customer. By working towards this direction and having in mind the characteristics and the habits of its customers, Top Kinisis does not see international travel portals as a threat to the alternative channel of distribution that it proposes. It seems that Cypriots prefer to do business with the local enterprises than someone out there in the Internet and market researches have shown that they are buying things from the Internet only if they can not find them in local enterprises. The former is considered to be very significant for the company's people but the management seem to be willing to take the risk for the implementation of the e-business project for various reasons. The most important is that they believe that they should be ahead of the competition.

The system inevitably will bring many changes to the organization's structures and processes but since the management did not disclose much information we cannot know details about these. We are allowed only to restrict ourselves to the company's estimations. The management is expecting that the company's employees will respond positively to the changes since the system is meant to help them do their job in a better and more efficient way. Another important factor that worth's to be assessed is the acceptance from the public, mainly by the company's customers. Again, a positive reaction is expected because it will be something new, friendly and very convenient to use.

Since the implementation plan already exists, we will assess some crucial factors about the implementation.

In this plan crucial factors are considered to be:

- People
- Existing Systems
- Existing and New Business Processes
- Promotion of the System

The people of the company are very important in the implementation of the new system. They are the people who will operate it and generally will be the system's alter ego. They must pass a training program for both the new system and the new culture and philosophy that the system will bring. It is very important to pay attention to the implementation of the new business processes and the new e-business processes and not to take shortcuts and reintroduce the quick and dirty old solutions of the past.

The key point here is the provision for integrating the new system with the existing legacy systems. Another issue is the data migration to the new system with as few problems as possible. A period of operating both old and new systems might be a good idea if it can be applicable. In most of the cases it will reduce the migration risks.

5.1.1.4.2.4 Business reengineering assessment

The same approach as to Tsaousis’s case was adopted for Top Kinisis case study. The questionnaire was given to an appropriate executive who answered it and provided Cyprus’s team with information regarding its situation.

5.1.1.4.2.4.1 The Questionnaire

This section contains the answered questionnaire regarding Top Kinisis case study. Based on the answers and ratings we will calculate the average complexity, found in the next section.

1 Business and Organizational issues

Business and Organizational issues attempt to assess the current state of the SME; the assessment is focused on business processes and organizational issues and aims in explaining the need for change, and illustrating the desired position the SME aspires to capture via the e-commerce system. This process can reveal critical factors about the SME’s organization and the business operations performed that orient the answer to the question whether the organization is ready to move to e-commerce and give indications as regards the level of the development effort needed for building a new or modifying an existing system.

Emphasis should be given on three key areas:

1.1 Business Goals

The responsibility of the analyst towards the business goals of the SME is to discover the business goals as they are defined by the management and evaluate them against the development complexity introduced into the system.

Q.1.1.1 What are the SMEs business goals in terms of extendibility, profit/budget and time limitations?

In terms of extendibility the SME wants to be the first e-travel portal in the local market. In terms of profit they have long term plans and in terms of budget they have relay stake a lot of money in the project.

In the case where business processes are transformed in a way that they fit better to an e-business oriented environment (i.e. transform delivery/order service) what is the complexity introduced into the system? Please consider budget, expected revenue, time and effort limitations in order to assess the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

Q.1.1.2 Is the management supportive in transforming the business to e-business? If the answer is yes, complexity could be low.

Since the project was originated by the management they strongly support it and they are highly committed to it.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.3 What will be the purpose of the developed web application?

To provide travel, tourism and hotel reservation services to the public and the tourist agents.

How complex is to achieve the application's purpose? i.e. in the case where the application serves informational reasons, the complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.4 What is SME's target audience? Do they have any e- experience?

The target audience is the public and the travel agents. The travel agents have experience with the older legacy reservation systems, which are not like modern web based systems.

Based on the customers' knowledge and experience what is the complexity introduced into the system? i.e. if they are experienced complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

Q.1.1.5 Which (current) business processes the SME would like to extend?

The SME is trying to expand the sales and informational business processes that is using. It looks towards of doing them more efficient.

How complex is to extend these business processes?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.6 Does the SME have the resources to accomplish it in terms of human resources? Please explain.

The SME has enough H.R. to accomplish this. If it is necessary they are going to hire new personnel.

Having in mind your human resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.7 Does the SME have the resources to accomplish it in terms of technical resources? Please explain.

The SME formed alliances with strategic technology providers in order to address this issue.

Having in mind your technical resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.8 Does the SME have the resources to accomplish it in terms of budget resources?
Please explain.

The SME has allocated own funds in order to support the project. Because of the projects magnitude, strategic investors also supported the project.

Having in mind your budget resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

Q.1.1.9 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of technical limitations?

The SME estimates that the complexity of doing the transformations is going to be high but because important technology providers support it, the management thinks that this will be resolved with success.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.10 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of budget limitations?

Since the SME has allocated great funds this is not a problem for them. Their problem is to administer the funds in an efficient manner.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.11 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of time limitations?

Time is a critical factor because of the SMEs commitment to their strategic investors and technology providers.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

1.2 Market Aspects

This section aims in assessing various market aspects as competitiveness and customers' expectations, and how these issues could affect the development of the ecommerce application. Therefore, the analyst should be informed on both market and SME environment.

Q.1.2.1 What is the present market competitiveness that the SME would have to face in the specific field it is occupied?

There is no local competition. The international competition is not competitive because of the local support and presence lack. Also price factor is on the SME side.

In what degree competitiveness could affect the complexity of the system? i.e. if competition is high, complexity could be high too.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

Q.1.2.2 At what degree does the management wish to compete in the target-market? Is the SME's management determined enough to dominate the target market? i.e. if the SME wishes to offer low-cost services to compete with other enterprises offering similar services it should have to find ways lowering internal costs, therefore introducing a higher complexity into the system.

The management is willing to compete and dominate the target market. Their effort is to create a market for this travel portal so they are willing to give offers and special packages. Their problem is that there is a great competition in this market and the profit margins are very low, so they can not do really impressive moves.

Based on the management's decision, what is the complexity introduced into the system? i.e. if the management expects to compete in a high scale then complexity could be high				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.2.3 Based on the SME's needs and expectations, do they require developing a more complex web application (include other innovating features/services)?

There are special requirements for this web application. That is why the SME formed alliances with technology providers. These needs are going to be covered by the technology solutions provided by these technology providers.

Based on your response, what is the complexity introduced into the system? i.e. if your response is positive, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.2.4 How effective is the existing system compared to the old? Consider the "pre e-business" SME's business processes toward the new business processes influenced by the adoption of the e-business concepts. Will the new way of doing business replace the existing one or will it work as an additional business channel?

The SME thinks that the new system is going to be very effective compared to the old. That is why they have invested so much on it. The new way of doing business will not replace completely the existing both of them are going to operate in parallel.

What is the complexity introduced into the system when one of the case is valid?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

Q.1.2.5 What required features/services are successfully implemented and widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

There are many features implemented by international competitors. The SME is going to implement most of them and it is going to customise them in order to be intergarted with its systems and the local services and needs.

What is the complexity introduced into the system to acquire these features/services? Having in mind that these features/services (i.e. payment gateways) are already implemented, complexity could be low if the features can easily be accessed by you.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.2.6 What required features/services are not widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

The services that are not implemented by the competition are how which have to do with the local market. The SME thinks that it is very important to implement these and provisions have been made towards this direction.

What is the complexity introduced into the system to implement these features? Having in mind that these features may not be already implemented, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.2.7 What is SME's estimation about the upper time bounds needed to complete the transformation to e-business? Is there any possibility for the demands of the marketplace to shift over until the transformation is finished?

Time is a critical factor for the projects success. Most of the services have to be launched before any local competitor shows up or before the international competitors acquire a significant market share.

Based on the time limits set by SME or the marketplace, what is the complexity introduced? Note that the smaller the time frame the higher the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

1.3 Human Resources

A vital component for the success of the e-commerce application is the human resources. This is due to the fact that complexity is introduced into the system, accordingly to employees and management behaviour and expertise.

Q.1.3.1 Is the management familiar with e-business processes?

I would say that the management is very familiar with e-business process. Further more they hire are area expert consultants to help the to take the right decisions.

Based on the management's familiarity with e-business processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.3.2 Are the employees familiar with Internet and e-commerce transactions?

The employees are not familiar with the Internet and e-commerce transactions but the management took provision for training for them.

Based on the employees' familiarity with internet and e-commerce transactions, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.3.3 Is there an adequately trained personnel for the new processes?

Yes. It is estimated that with the new more efficient processes the SME can save human hours. They have planed to put these human hours to support the new processes.

Based on the personnel's training for the new processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.4 Who will be maintaining the site? Is he/she knowledgeable to do so? If the answer is yes, complexity could be low.

The technology providers will train company's personnel for that purpose.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.3.5 What are the employees' feelings in re-engineering their current processes?

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The employees feel that this re-engineering threatens their position, but the management assured them that this not the case. I still believe that the employees will not rest about that.

Based on the employees' feelings in re-engineering their current processes, what is the complexity introduced into the system? i.e. if they have positive feelings, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.3.6 What are the customers' expectations of the e-commerce system?

The customers always need to have good service quality in the right price. So customers expect much from this project.

Based on the customers' expectations, what is the complexity introduced into the system? i.e. if they have high expectations, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

Q.1.3.7 What is the current level of cooperation and communication within the SME environment (i.e. employees, management)?

The communication level is quite good but one can not foretell what is going to happen if the way of doing the job changes dramatically in a way that it will influence the personnel number.

Based on the level of cooperation and communication between within the SME environment, what is the complexity introduced into the system? i.e. if communication is in line, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

2 + 3. Application domain aspects and Quality Requirements

The categorization of the various types of Web applications assists in estimating their level of complexity and the development effort required.

Please identify which of the following types of web applications apply to your application and estimate the effort and complexity needed to implements each type (it could be more than one). In addition, please list the emphasis you place on each quality requirement which applies into your application.

Types of Web Application	Please choose					Quality Requirements	Please choose				
	0	0.25	0.5	0.75	1		0	0.25	0.5	0.75	1
<i>Informational</i> Read-only content with navigation and links.			X			Usability					X
						Functionality					X
						Reliability					X

					Efficiency					X
					Maintainability					X
<i>Download</i> Information available for downloading by the user.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Customizable</i> Content can be customized based on user needs.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Interaction</i> Communication among users via chat rooms, bulletin boards, or instant messaging.			X		Usability					X
					Functionality				X	
					Reliability					X
					Efficiency				X	
					Maintainability		X			
<i>User input</i> Communication via online forms.		X			Usability		X			
					Functionality				X	
					Reliability		X			
					Efficiency				X	
					Maintainability			X		
<i>Transaction oriented</i> Order processing (products and services).				X	Usability					X
					Functionality					X
					Reliability					X
					Efficiency					X
					Maintainability					X
<i>Service oriented</i> The application provides an online service (e.g. estimating a mortgage payment).		X			Usability				X	
					Functionality			X		
					Reliability				X	
					Efficiency			X		
					Maintainability				X	
<i>Portal</i> A starting point that channels the user to other Web applications outside the domain of the portal application.	X				Usability				X	
					Functionality				X	
					Reliability					X
					Efficiency			X		
					Maintainability				X	
<i>Database access</i> Querying a database and retrieving information.		X			Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Data warehousing</i> Querying a collection of large databases and retrieving information.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				

5.1.1.4.2.4.2 Analysis

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As we mentioned, the analysis and the calculation of the mean complexity are based on the proposed formulas from section 4.2.1 Cyprus implementation which are used for Tsaousis case study.

The first part of the questionnaire is the “Business and Organizational Issues”, which is subdivided into three key areas: Business goals, Market aspects and Human resources. The formula corresponding to the first part of the questionnaire is the following:

$$C_{1,j} = \frac{\sum Q_i}{i}$$

Having in mind the rating given in the questionnaire we are going to calculate the complexity associated with Business goals, Market aspects and Human resources sections respectively.

We first start with the Business Goals section. The following values are taken from the questionnaire and correspond sequentially to the rating given 1, 0.25, 0.5, 1, 0.75, 0.75, 0.5, 1, 0.75, 0.75, 0.75 . To apply the formula, we first need to add all the values and then divide by their plurality. Therefore, $C_{1,1} = 8/11 = 0.727$.

Top Kinisis is very focused as of what they expect of the eCommerce application. This SME has high expectations as it is determined to be the first e-travel portal in Cyprus and dominate the local market. Technical, budget and time issues are considered critical for the success of the new system. Therefore the complexity of the Business goals is high, 0.727.

The values corresponding to Market aspects are: 1, 0.75, 0.75, 1, 0.75, 0.75, 0.25. With the same formula as used previously we calculate the complexity $C_{1,2} = 5.25/7 = 0.75$.

As we observe, the complexity of the market aspects is also high, 0.75. Although there is no local or international competition, complexity is introduced into the system due to the competition of the traditional channels. In addition, the need for designing and implementing innovating services introduces extra overhead to the complexity for implementing the new system.

Last area is Human resources and the associated values are: 0.75, 0.5, 0.25, 0.75, 0.75, 1, 0. By applying the same formula as before we have the following result $C_{1,3} = 4/7 = 0.571$.

Regarding human resources, the complexity introduced into the system is medium, 0.571. Complexity here is associated with the employees’ and the management’s expertise. Top Kinisis management is very familiar with e-business processes but employees are not. Although this is not considered an obstacle, they have given great emphasis and taken provisions to solve the situation.

Therefore, the mean complexity value for the Business and Organizational Issues is the following: Mean complexity (BandOI) = $(0.727 + 0.75 + 0.571)/3 = 0.682$.

We continue our calculations by computing the mean complexity for the rest of the categories included in the questionnaire. First, we need to analyse Application domain ratings and then Quality requirements ratings.

The values associates with the Application domain are as follows: Informational $C_{3,1}=0.5$, Download $C_{3,2}=0$, Customisable $C_{3,3}=0$, Interaction $C_{3,4}=0.5$, User Input $C_{3,5}=0.25$, Transaction oriented $C_{3,6}=1$, Service oriented $C_{3,7}=0.25$, Portal $C_{3,8}=0$, Database access $C_{3,9}=0.25$, Database warehousing $C_{3,10}=0$. The average complexity for this area is associated only with the non-zero values; therefore Mean Complexity (Application domain)= $2.75/6=0.458$.

Like Tsaousis, Top Kinisis estimates that customers will approach its website for getting information on travels and various offers or they could use other online services provided on the web site. So far the complexity is estimated to be low to medium due to the simplicity of the processes. Complexity is significantly increased for interacting with the system and transacting online. Top Kinisis needs to attract potential customers through the web site. Therefore it is very important to have a marketing strategy aside such as create contact channels with the customers or build trust relationships with the customers so that they will be confident for the security provided by the company and transact online. That is why the overall complexity introduced into the system by the application domain is increased to 0.458. The calculation of the Quality Requirements section is a bit more complex that the other sections as we first have normalize the complexity for each Application domain which is associated with specific quality requirements in order use the normalized value as weight to computed the weighted average of each quality requirements .

We use the following formula which normalizes the averages of each application domain (we divide the specified application domain complexity with the summation of all the application domain complexity values):

$$\hat{C}_{3,i} = C_{3,i} / \sum_j C_{3,j}$$

Where i,j is the web application types

Informational $\hat{C}_{3,1} = 0.5/2.75=0.181$

Download $\hat{C}_{3,2} = 0/2.75=0$

Customizable $\hat{C}_{3,3} = 0/2.75=0$

Interaction $\hat{C}_{3,4} = 0.5/2.75=0.181$

User Input $\hat{C}_{3,5} = 0.25/2.75=0.09$

Transaction oriented $\hat{C}_{3,6} = 1/2.75=0.363$

Service oriented $\hat{C}_{3,7} = 0.25/2.75=0.09$

Portal $\hat{C}_{3,8} = 0/2.75=0$

Database access $\hat{C}_{3,9} = 0.25/2.75=0.09$

Database warehousing $\hat{C}_{3,10} = 0/2.75=0$

To estimate the complexity of each quality requirement we use the following formula. The basic idea is to put the normalized values of each web application type as the weight for the contribution of the quality requirement of each type.

$$C_{2,i} = \sum_j (C_{2,i} * \hat{C}_{3,j})$$

Where i stands for the quality requirement and j stands for the web application type.

Usability $C_{2,1} = 1*0.181 + 1*0.181 + 0.25*0.09 + 1*0.363 + 0.75*0.09 = 0.815$

Functionality $C_{2,2} = 1*0.181 + 0.75*0.181 + 0.75*0.09 + 1*0.363 + 0.5*0.09 = 0.791$

Reliability $C_{2,3} = 1*0.181 + 1*0.181 + 0.25*0.09 + 1*0.363 + 0.75*0.09 = 0.815$

Efficiency $C_{2,4} = 1*0.181 + 0.75*0.181 + 0.75*0.09 + 1*0.363 + 0.5*0.09 = 0.791$

Maintainability $C_{2,5} = 1*0.181 + 0.25*0.181 + 0.5*0.09 + 1*0.363 + 0.75*0.09 = 0.679$

The Mean complexity (Quality requirements) = $3.891/5 = 0.778$.

The quality requirements score a higher complexity also. In general, Top Kinisis requires usability so that people with no e-experience could easily use its website, especially why the web site will provide more complex services that the usual eCommerce applications. Functionality is required to serve expectation of all potential customers so that they will support the system and congestion of the traditional channel is minimized. Considerations are also made for reliability, efficiency and maintainability issues as an error-free system that quickly processes requests is a necessity for any successful eCommerce application.

The table bellow shows a summary of the values as they were computed in the previous section. Using the values above we will now compute the average complexity.

Table 4 - Top Kinisis Analysis

Components	Factors	
Business Assessment	Business goals	0,727
	Market aspects	0,75
	Human resources	0,571
Mean		0,682
Quality Requirements	Usability	0,815
	Functionality	0,791
	Reliability	0,815
	Efficiency	0,791
	Maintainability	0,679
Mean		0,778
Application Domain	Informational	0,5
	Download	0
	Customizable	0
	Interaction	0,5
	User Input	0,25
	Transaction oriented	1
	Service oriented	0,5

	Portal	0
	Database access	0,25
	Database warehousing	0
Mean		0,458

$$Av_compl = mean \left(\begin{array}{l} mean(C_{1,i}, i = 1..3) + mean(C_{2,j}, j = 1..5) \\ + mean(C_{3,k}, k = 1..8 \wedge C_{3,k} \neq 0) \end{array} \right)$$

Therefore,

$$Av_compl = (0.682 + 0.778 + 0.458) / 3 = 0.639$$

where the result is over 0.5 and long path cycle should be followed.

Appendix II – Complexity Calculations shows an excel file that was used for the calculations.

5.1.1.4.2.5 Conclusions

Top Kinisis wants to become the market's leader and expand its business. In parallel, it aims to cut cost, use its resources, especially human resources, in a more efficient and productive way and reengineer the business's processes in order to simplify and automate as much as possible its interaction with customers and associates. The e-business strategy fits in all ways with the business strategy. This is because the management believes that by introducing e-business in Business-to-Customer and Business-to-Business they will be able to achieve most of their strategic plans. Of course e-business is not a magic spell, which will turn their business into a Swiss clock, but their belief is that e-business can provide them with the mechanism to evolve their company.

5.1.1.4.3 Objects (Pantelides Papachristodoulou Ltd)

5.1.1.4.3.1 Company Profile

The SME is in the business of cultivating a gracious lifestyle. Objects do not simply sell exquisitely appealing goods, but offers the possibility of a new approach to the custom of giving and the ritual of shopping.

Strengthened by their common sense of purpose, shared values and dedication to achieving goals set by them for themselves, they have created and are sustaining a formidable market force. All of their operations are online, helping to ensure efficient service.

The possibility of enriching the choice of elegant products available at OBJECTS is actively encouraged. This is part of a never-ending commitment to constantly reassess their approach and surpass, rather than merely meet, expectations. There is always room for something different, as long as it's up to their rigid criteria.

They concentrate on sharpening their hands-on market knowledge to prudently grow the business in direct response to shifts in demand. What appeals to them most is the potential of using the momentum of their impact on the gift sector to propel them into diversified interests in the retail trade.

5.1.1.4.3.2 Feasibility Study – Key issues identified

The company's main focus is to offer to their customers another channel of product distribution through Internet. They "own" the customers, they have relationships with them and now they are going to offer them a new utility, their e-Shop. It will be very useful for them to include in their business practices a good customer relationship management, this will personalize the company's relationship with their customers and it will improve the interaction between the company and the customer.

The company is ready to invest significant efforts and resources in the e-commerce perspective business. The investment consists of the e-commerce store hardware and software, the recurring fees of the stores connectivity to the Internet, and the recurring maintenance costs of the store. They are ready to allocate human resources in order to update the portal and take care of the sales through the Internet.

5.1.1.4.3.3 Risks Identified

The estimated risk for this initiative is considered to be low because of the way that Objects views the e-business opportunity. The SME sees e-business as another channel of doing business and through this it is targeting customers that it is impossible to have. If you consider that e-commerce is not very well known in the country, the pioneers will benefit and since the running costs of the e-commerce portal are fairly low the risk is estimated low. The reaction of the customers is considered to be unpredictable although there are indications that people are keen on this kind of innovations.

There is evidence that the public's reaction will not be positive due to the small volumes of the other e-commerce portals, which are not considered to be successful business cases. In that case, the portal can act as a complement to the other firm's channels of sales.

The management believes that the key to the success of this electronic shop project will be a campaign in order to advertise it and inform the public and the customers for its existence and the services been offered by this portal.

5.1.1.4.3.4 Business reengineering assessment

As it is mentioned earlier, Cyprus considers the development of a detailed questionnaire as the best way to implement the proposed methodology. Cyprus believes that through the questionnaire we could gather the necessary information to describe the business environment within Cyprus. For this reason, the questionnaire was given to executives, who had the knowledge to provide information.

After the completion of each questionnaire, Cyprus team analyzed the responses and calculated the mean complexity based on the ratings that were given by the executives. The calculated complexity determined the cycle (short or long) that each company has to follow to reengineer its business environment.

5.1.1.4.3.4.1 The Questionnaire

1 Business and Organizational issues

Business and Organizational issues attempt to assess the current state of the SME; the assessment is focused on business processes and organizational issues and aims in explaining the need for change, and illustrating the desired position the SME aspires to capture via the e-commerce system. This process can reveal critical factors about the SME's organization and the business operations performed that orient the answer to the question whether the organization is ready to move to e-commerce and give indications as regards the level of the development effort needed for building a new or modifying an existing system.

Emphasis should be given on three key areas:

1.1 Business Goals

Q.1.1.1 What are the SMEs business goals in terms of extendibility, profit/budget and time limitations?

The SME wants to expand its sales through Internet. The whole project is identified as a medium risk therefore the budget for it is going to be low to medium and the profit expectations are medium. Time is not so critical.

In the case where business processes are transformed in a way that they fit better to an e-business oriented environment (i.e. transform delivery/order service) what is the complexity introduced into the system? Please consider budget, expected revenue, time and effort limitations in order to assess the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.2 Is the management supportive in transforming the business to e-business? If the answer is yes, complexity could be low.

Yes, because the management initiated the project,

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.3 What will be the purpose of the developed web application?

Sell goods and have a catalogue on-line

How complex is to achieve the application's purpose? i.e. in the case where the application serves informational reasons, the complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.4 What is SME's target audience? Do they have any e- experience?

Young persons mostly women within the ages of 25-40 with high income status, who know how to browse in the Internet.

Based on the customers' knowledge and experience what is the complexity introduced into the system? i.e. if they are experienced complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.5 Which (current) business processes the SME would like to extend?

Purchasing, Ordering, Payment on-line and Delivery of goods

How complex is to extend these business processes?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.6 Does the SME have the resources to accomplish it in terms of human resources?
Please explain.

Yes, the director of the company will personally be involved and his involvement is enough.

Having in mind your human resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.1.7 Does the SME have the resources to accomplish it in terms of technical resources?
Please explain.

As the above.

Having in mind your technical resources, how complex is to achieve				
--	--	--	--	--

extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.8 Does the SME have the resources to accomplish it in terms of budget resources? Please explain.

The demanded budget is very low so this is not important issue for the company.

Having in mind your budget resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.9 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of technical limitations?

The SME is not going to perform this kind of transformation. It is going to keep its current processes.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.10 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of budget limitations?

There are no budget limitations.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.11 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of time limitations?

Time limitations do not apply here.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

1.2 Market Aspects

This section aims in assessing various market aspects as competitiveness and customers' expectations, and how these issues could affect the development of the ecommerce application. Therefore, the analyst should be informed on both market and SME environment.

Q.1.2.1 What is the present market competitiveness that the SME would have to face in the specific field it is occupied?

Competitors are Villeroy & Boch, Proton & Royal Dalton.

In what degree competitiveness could affect the complexity of the system? i.e. if competition is high, complexity could be high too.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.2.2 At what degree does the management wish to compete in the target-market? Is the SME's management determined enough to dominate the target market? i.e. if the SME wishes to offer low-cost services to compete with other enterprises offering similar services it should have to find ways lowering internal costs, therefore introducing a higher complexity into the system.

The management want to dominate to the market. The critical factor to success will be the quality and efficiencies of their services.

Based on the management's decision, what is the complexity introduced into the system? i.e. if the management expects to compete in a high scale then complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.2.3 Based on the SME's needs and expectations, do they require developing a more complex web application (include other innovating features/services)?

Basic e-Commerce site is required initially.

Based on your response, what is the complexity introduced into the system? i.e. if your response is positive, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.2.4 How effective is the existing system compared to the old? Consider the "pre e-business" SME's business processes toward the new business processes influences by the adoption of the e-business concepts. Will the new way of doing business replace the existing one or will it work as an additional business channel?

Since the e-commerce system is going to be separated from the traditional way of doing business, one cannot give answer to this question.

What is the complexity introduced into the system when one of the case is valid?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.2.5 What required features/services are successfully implemented and widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

There is no need for special features.

What is the complexity introduced into the system to acquire these features/services? Having in mind that these features/services (i.e. payment gateways) are already implemented, complexity could be low if the features can easily be accessed by you.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.2.6 What required features/services are not widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

There are no features that are not widely used by others in the same or similar business market.

What is the complexity introduced into the system to implement these features? Having in mind that these features may not be already implemented, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.2.7 What is SME's estimation about the upper time bounds needed to complete the transformation to e-business? Is there any possibility for the demands of the marketplace to shift over until the reengineering is finished?

Need to be completed and up and running quickly to be in front of the expected future competition.

Based on the time limits set by SME or the marketplace, what is the complexity introduced? Note that the smaller the time frame the higher the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

1.3 Human Resources

Q.1.3.1 Is the management familiar with e-business processes?

Yes, in a degree.

Based on the management's familiarity with e-business processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.2 Are the employees familiar with Internet and e-commerce transactions?

Yes

Based on the employees' familiarity with internet and e-commerce transactions, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.3 Is there an adequately trained personnel for the new processes?

Yes. The current staff.

Based on the personnel's training for the new processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.4 Who will be maintaining the site? Is he/she knowledgeable to do so? If the answer is yes, complexity could be low.

The director of the company will be trained.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.5 What are the employees' feelings in re-engineering their current processes?

They support this new transformation.

Based on the employees' feelings in re-engineering their current processes, what is the complexity introduced into the system? i.e. if they have positive feelings, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.3.6 What are the customers' expectations of the e-commerce system?

Does not know what to expect as it has never been implemented for their line of products ever

Based on the customers' expectations, what is the complexity introduced into the system? i.e. if they have high expectations, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.3.7 What is the current level of cooperation and communication within the SME environment (i.e. employees, management)?

Excellent

Based on the level of cooperation and communication between within the SME environment, what is the complexity introduced into the system? i.e. if communication is in line, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

2 + 3. Application domain aspects and Quality Requirements

The categorization of the various types of Web applications assists in estimating their level of complexity and the development effort required.

Please identify which of the following types of web applications apply to your application and estimate the effort and complexity needed to implements each type (it could be more than one). In addition, please list the emphasis you place on each quality requirement which applies into your application.

Types of Web Application	Please choose					Quality Requirements	Please choose				
	0	0.25	0.5	0.75	1		0	0.25	0.5	0.75	1
<i>Informational</i> Read-only content with navigation and links.			X			Usability			X		
						Functionality			X		
						Reliability			X		
						Efficiency			X		
						Maintainability			X		
<i>Download</i> Information available for downloading by the user.	X					Usability	X				
						Functionality	X				
						Reliability	X				
						Efficiency	X				
						Maintainability	X				
<i>Customizable</i> Content can be customized based on user needs.	X					Usability	X				
						Functionality	X				
						Reliability	X				
						Efficiency	X				
						Maintainability	X				
<i>Interaction</i> Communication among users via chat rooms, bulletin boards, or instant messaging.		X				Usability			X		
						Functionality		X			
						Reliability			X		
						Efficiency			X		
						Maintainability		X			
<i>User input</i> Communication via online forms.		X				Usability			X		
						Functionality		X			
						Reliability		X			
						Efficiency			X		
						Maintainability		X			
<i>Transaction oriented</i> Order processing					X	Usability					X
						Functionality					X

(products and services).					Reliability					X
					Efficiency				X	
					Maintainability				X	
<i>Service oriented</i> The application provides an online service (e.g. estimating a mortgage payment).		X			Usability		X			
					Functionality			X		
					Reliability			X		
					Efficiency		X			
					Maintainability		X			
<i>Portal</i> A starting point that channels the user to other Web applications outside the domain of the portal application.		X			Usability			X		
					Functionality			X		
					Reliability		X			
					Efficiency		X			
					Maintainability		X			
<i>Database access</i> Querying a database and retrieving information.			X		Usability				X	
					Functionality			X		
					Reliability			X		
					Efficiency				X	
					Maintainability		X			
<i>Data warehousing</i> Querying a collection of large databases and retrieving information.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				

5.1.1.4.3.4.2 Analysis

The analysis and the calculation of the mean complexity are based on the proposed formulas described in a previous section.

The first part of the questionnaire is the “Business and Organizational Issues”, which is subdivided into three key areas: Business goals, Market aspects and Human resources. The formula corresponding to the first part of the questionnaire is the following:

$$C_{1,j} = \frac{\sum_i Q_i}{i}$$

Having in mind the rating given in the questionnaire we are going to calculate the complexity associated with Business goals, Market aspects and Human resources sections respectively.

We first start with the Business Goals section. The following values are taken from the questionnaire and correspond sequentially to the rating given: 0.5, 0.25, 0.5, 0.25, 0.5, 0, 0.25, 0.25, 0.25, 0.25. To apply the formula, we first need to add all the values and then divide by their plurality. Therefore, $C_{1,1} = 3.25/11 = 0.3$.

This company is willing to invest significant efforts in offering another channel of products to their customers. Estimations show that the development of its web application will not constitute a barrier for the company. Time is not a critical issues, nether the budget. The

management is very supportive and it will be personally involved with the transformation. Therefore the complexity of the Business goals is low, 0.3.

The values corresponding to Market aspects are: 0.5, 0.75, 0, 0, 0, 0, 0.5. With the same formula as used previously we calculate the complexity $C_{1,2} = 1.75/7 = 0.25$.

Although that there is some competition and the management wants to dominate the market, it doesn't require a specialized ecommerce site with brand new features/services. This is the reason so that the complexity of the market aspects is also low, 0.25.

Last area is Human resources and the associated values are: 0.25, 0.25, 0.25, 0.25, 0, 0.5, 0.25. By applying the same formula as before we have the following result $C_{1,3} = 1.75/7 = 0.25$.

The complexity for the Human resources is low, 0.25. This is due to the reason that the management and employees are familiar with e-business processes and there is trained personnel in place for the new processes. Also, the communication level within the company is excellent, something that makes things easier.

Therefore, the mean complexity value for the Business and Organizational Issues is the following: Mean complexity (BandOI) = $(0.3 + 0.25 + 0.25)/3 = 0.27$.

We continue our calculations by computing the mean complexity for the rest of the categories included in the questionnaire. First, we need to analyze Application domain ratings and then Quality requirements ratings.

The values associates with the Application domain are as follows: Informational 0.5, Download 0, Customizable 0, Interaction 0.25, User Input 0.25, Transaction oriented 1, Service oriented 0.25, Portal 0.25, Database access 0.5, Database warehousing 0. The average complexity for this area is associated only with the non-zero values; therefore Mean Complexity (Application domain) = $3/7 = 0.42$.

Objects estimates that customers will use the new channel of product distribution to search for specific items and purchase them online or use other services that are provided on the site. In addition, the company requires a basic ecommerce site so complexity is estimated to be low due to the simplicity of the processes. The online transactions add an overhead to the system as they increase complexity due to the fact that extra mechanisms are needed to secure the transactions. That is why the overall complexity introduced into the system by the application domain is increased to 0.42.

The calculation of the Quality Requirements section is a bit more complex that the other sections as we first have to compute the weighted complexity of each Application domain which is associated with specific quality requirements.

We use the following formula to compute the weighted complexity (we divide the specified application domain complexity with the summation of all the application domain complexity values):

$$\hat{C}_{3,i} = C_{3,i} / \sum_j C_{3,j}$$

Where i, j is the web application types

Informational $C_{3,1} = 0.5/3 = 0.167$	Download $C_{3,2} = 0/3 = 0$
Customizable $C_{3,3} = 0/3 = 0$	Interaction $C_{3,4} = 0.25/3 = 0.083$
User Input $C_{3,5} = 0.25/3 = 0.083$	Transaction oriented $C_{3,6} = 1/3 = 0.333$
Service oriented $C_{3,7} = 0.25/3 = 0.083$	Portal $C_{3,8} = 0.25/3 = 0.083$
Database access $C_{3,9} = 0.5/3 = 0.167$	Database warehousing $C_{3,10} = 0/3 = 0$

To estimate the complexity of each quality requirement we use the following formula. The basic idea is to put the normalized values of each web application type as the weight for the contribution of the quality requirement of each type.

$$C_{2,i} = \sum_j (C_{2,i} * \hat{C}_{3,j})$$

Where i stands for the quality requirement and j stands for the web application type.

Usability $C_{2,1} = 0.5*0.167 + 0.5*0.083 + 0.5*0.083 + 1*0.333 + 0.25*0.083 + 0.5*0.083 + 0.5*0.167 = 0.688$

Functionality $C_{2,2} = 0.5*0.167 + 0.25*0.083 + 0.25*0.083 + 1*0.333 + 0.5*0.083 + 0.5*0.083 + 0.5*0.167 = 0.625$

Reliability $C_{2,3} = 0.5*0.167 + 0.5*0.083 + 0.25*0.083 + 1*0.333 + 0.5*0.083 + 0.25*0.083 + 0.5*0.167 = 0.625$

Efficiency $C_{2,4} = 0.5*0.167 + 0.5*0.083 + 0.5*0.083 + 0.75*0.333 + 0.25*0.083 + 0.25*0.083 + 0.5*0.167 = 0.583$

Maintainability $C_{2,5} = 0.5*0.167 + 0.25*0.083 + 0.25*0.083 + 0.75*0.333 + 0.25*0.083 + 0.25*0.083 + 0.25*0.167 = 0.458$

The Mean complexity (Quality requirements) = $0.593/5 = 0.596$.

The quality requirements score a higher complexity also. In general, Objects requires usability so that people with no e-experience could easily use its website; functionality is required to serve expectation of all potential customers. Considerations are also made for reliability, efficiency and maintainability issues as an error-free system that quickly processes requests is a necessity for a successful ecommerce application.

Table 5 - Objects Analysis

Components	Factors	
Business Assessment	Business goals	0,3
	Market aspects	0,25
	Human resources	0,25
Mean		0,27
Quality Requirements	Usability	0,69
	Functionality	0,625
	Reliability	0,625
	Efficiency	0,583
	Maintainability	0,458
Mean		0,596
Application Domain	Informational	0,5
	Download	0
	Customisable	0
	Interaction	0,25
	User Input	0,25
	Transaction oriented	1
	Service oriented	0,25
	Portal	0,25
	Database access	0,5
	Database warehousing	0
Mean		0,42

Finally, by using the following formula we compute the overall average complexity.

$$Av_compl = mean \left(\begin{array}{l} mean(C_{1,i}, i = 1..3) + mean(C_{2,j}, j = 1..5) \\ + mean(C_{3,k}, k = 1..8 \wedge C_{3,k} \neq 0) \end{array} \right)$$

Therefore,

$$Av_compl = (0.27 + 0.596 + 0.42) / 3 = 0.43$$

where the result is below 0.5 and short path cycle should be followed.

Appendix II – Complexity Calculations shows an excel file that was used for the calculations.

5.1.1.4.3.5 Conclusions

The company's strategic targets and goals remain the same; that is they want to be able to sell exquisitely appealing goods and offer the possibility of a new approach to the custom of giving and the ritual of shopping. At the same time, they want to give incentives to customers to buy through the Internet. This can be done by offering products in lower prices than the physical stores.

Moreover, they must automate their stock control in order to keep up with the selling's from stores plus the e-shop. Another thing they have to do is to reorganize the way they use their

resources, especially technical resources, in more effective way so that they could more efficient serve their clients how place orders through Internet.

5.1.1.4.4 Dora Schabel Ltd

5.1.1.4.4.1 Company Profile

Dora Schabel Ltd is a Design Studio, established in 1999, specializing in unique, high quality, richly textured, and diversely constructed, handmade, leather handbags and belts that reflect the designer's interest in the arts.

The company is successfully established in Cyprus, providing its clientele with sculptural leather accessories, unexpectedly combined with materials such as hand blown glass, painted leather and sculpted metal, pursuing the company's interest in promoting and incorporating art into fashion.

The company's continuing plan is to establish and develop collaborations with fine artists and craftsmen who will enhance the artistic and unique nature of its products and who will provide sculptural and traditional techniques carried into contemporary fashion designs.

5.1.1.4.4.2 Feasibility Study – Key issues identified

The company's main focus is, mainly, to offer to their customers another channel of information about their products and secondly, to sell them through Internet. They "own" the customers, they have relationships with them and now they are going to offer them a new utility, their e-Shop. It will be very useful for them to include in their business practices a good customer relationship management, this will personalize the company's relationship with their customers and it will improve the interaction between the company and the customer.

The company is ready to invest significant efforts and resources in the e-commerce perspective business. The investment consists of the e-commerce store hardware and software, the recurring fees of the stores connectivity to the Internet, and the recurring maintenance costs of the store. They are ready to allocate human resources in order to update the portal and take care of the sales through the Internet.

5.1.1.4.4.3 Risks Identified

The estimated risk for this initiative is considered to be low because of the way that Dora Schabel views the e-business opportunity. The SME sees e-business as another channel of doing business and through this it is targeting customers that it is impossible to have. If you

consider that e-commerce is not very well known in the country, the pioneers will benefit and since the running costs of the e-commerce portal are fairly low the risk is estimated low. At the same time the SME wants to build a channel with clients in other countries like USA, Japan, England etc. The reaction of the customers is considered to be unpredictable although there are indications that people are keen on this kind of innovations.

There is evidence that the public's reaction will not be positive due to the small volumes of the other e-commerce portals, which are not considered to be successful business cases. In that case, the portal can act as a complement to the other firm's channels of sales.

The management believes that the key to the success of this electronic shop project will be a campaign in order to advertise it and inform the public and the customers for its existence and the services been offered by this portal.

5.1.1.4.4.4 Business reengineering assessment

As it is mentioned earlier, Cyprus considers the development of a detailed questionnaire as the best way to implement the proposed methodology. Cyprus believes that through the questionnaire we could gather the necessary information to describe the business environment within Cyprus. For this reason, the questionnaire was given to executives, who had the knowledge to provide information.

After the completion of the two questionnaires, Cyprus team analyzed the responses and calculated the mean complexity based on the ratings that were given by the executives. The calculated complexity determined the cycle (short or long) that each company has to follow to reengineer its business environment.

5.1.1.4.4.1 The Questionnaire

1 Business and Organizational issues

Business and Organizational issues attempt to assess the current state of the SME; the assessment is focused on business processes and organizational issues and aims in explaining the need for change, and illustrating the desired position the SME aspires to capture via the e-commerce system. This process can reveal critical factors about the SME's organization and the business operations performed that orient the answer to the question whether the organization is ready to move to e-commerce and give indications as regards the level of the development effort needed for building a new or modifying an existing system.

Emphasis should be given on three key areas:

1.1 Business Goals

The responsibility of the analyst towards the business goals of the SME is to discover the business goals as they are defined by the management and evaluate them against the development complexity introduced into the system.

Q.1.1.1 What are the SMEs business goals in terms of extendibility, profit/budget and time limitations?

The SME wants to expand its awareness through the Internet, but at the same time can't raise the productivity because of the limited resources and the fact that the product maintains its hand crafted nature. Therefore the budget it is going to be low. Time is not so critical.

In the case where business processes are transformed in a way that they fit better to an e-business oriented environment (i.e. transform delivery/order service) what is the complexity introduced into the system? Please consider budget, expected revenue, time and effort limitations in order to assess the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.2 Is the management supportive in transforming the business to e-business? If the answer is yes, complexity could be low.

Yes, because is one person company.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.1.3 What will be the purpose of the developed web application?

Is to implement, firstly, an informative and secondly, an electronic sales outlet for the SMEs product.

How complex is to achieve the application's purpose? i.e. in the case where the application serves informational reasons, the complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.4 What is SME's target audience? Do they have any e- experience?

High income female of any age that require individuality and merchants that would like to resell these products. The former target has minimum experience in e-related technology with the later depending on the merchant.

Based on the customers' knowledge and experience what is the complexity introduced into the system? i.e. if they are experienced complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

		X		
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Q.1.1.5 Which (current) business processes the SME would like to extend?

There are no business processes to extend, so the SME is preparing new business processes for the e-commerce environment.

How complex is to extend these business processes?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.6 Does the SME have the resources to accomplish it in terms of human resources?
Please explain.

No, but plans to recruit.

Having in mind your human resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.7 Does the SME have the resources to accomplish it in terms of technical resources?
Please explain.

No, but plans to. Till that time is expecting that will have the necessary technical support from the Virtual Mall, in terms of inserting new products, changing the look & feel of the store etc.

Having in mind your technical resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.8 Does the SME have the resources to accomplish it in terms of budget resources?
Please explain.

Yes. The demanded budget is very low so this is not a very important issue for the company.

Having in mind your budget resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.9 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of technical limitations?

There are only basic procedures available and therefore no major re-engineering is required. SME is working currently as mail order sales establishment.

Please choose				
Absent	Low	Medium	High	Ultimate

(0)	(0.25)	(0.5)	(0.75)	(1)
	X			

Q.1.1.10 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of budget limitations?

See above. Budget limitations do not apply here.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.1.11 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of time limitations?

See above. Time limitations do not apply here.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

1.2 Market Aspects

This section aims in assessing various market aspects as competitiveness and customers' expectations, and how these issues could affect the development of the ecommerce application. Therefore, the analyst should be informed on both market and SME environment.

Q.1.2.1 What is the present market competitiveness that the SME would have to face in the specific field it is occupied?

Competition is big designer names that sell expensive through stores. The hand made aspect hardly exists in the internet and therefore considered as unique product and market.

In what degree competitiveness could affect the complexity of the system? i.e. if competition is high, complexity could be high too.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.2 At what degree does the management wish to compete in the target-market? Is the SME's management determined enough to dominate the target market? i.e. if the SME wishes to offer low-cost services to compete with other enterprises offering similar services it should have to find ways lowering internal costs, therefore introducing a higher complexity into the system.

High, is not willing to provide low cost services.

Based on the management's decision, what is the complexity introduced into the system? i.e. if the management expects to compete in a high scale then complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

		(0.5)		(1)
		X		

Q.1.2.3 Based on the SME's needs and expectations, do they require developing a more complex web application (include other innovating features/services)?

Basic e-Commerce site is required initially. In the future under certain conditions custom made product selection will be required.

Based on your response, what is the complexity introduced into the system? i.e. if your response is positive, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.4 How effective is the existing system compared to the old? Consider the "pre e-business" SME's business processes toward the new business processes influences by the adoption of the e-business concepts. Will the new way of doing business replace the existing one or will it work as an additional business channel?

Similar business but orders will come from the Internet. The new way of doing business will work as an additional business channel.

What is the complexity introduced into the system when one of the case is valid?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.5 What required features/services are successfully implemented and widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

There is no need for special features.

What is the complexity introduced into the system to acquire these features/services? Having in mind that these features/services (i.e. payment gateways) are already implemented, complexity could be low if the features can easily be accessed by you.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.2.6 What required features/services are not widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

There are no other sites for selling hand-made bugs and belts on-line.

What is the complexity introduced into the system to implement these features? Having in mind that these features may not be already implemented, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.2.7 What is SME's estimation about the upper time bounds needed to complete the transformation to e-business? Is there any possibility for the demands of the marketplace to shift over until the transformation is finished?

As far as this SME concerns there will be a controlled transformation to e-business.

Based on the time limits set by SME or the marketplace, what is the complexity introduced? Note that the smaller the time frame the higher the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

1.3 Human Resources

A vital component for the success of the e-commerce application is the human resources. This is due to the fact that complexity is introduced into the system, accordingly to employees and management behaviour and expertise.

Q.1.3.1 Is the management familiar with e-business processes?

Yes, the director's knowledge is adequate enough.

Based on the management's familiarity with e-business processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.2 Are the employees familiar with Internet and e-commerce transactions?

No, will need training

Based on the employees' familiarity with internet and e-commerce transactions, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.3.3 Is there an adequately trained personnel for the new processes?

No, will require training but because it is one person company this will not add any extra complexity to the system

Based on the personnel's training for the new processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.4 Who will be maintaining the site? Is he/she knowledgeable to do so? If the answer is yes, complexity could be low.

Mainly, the manager that she will be trained for this purpose.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.3.5 What are the employees' feelings in re-engineering their current processes?

The new environment is not going to influence their current process.

Based on the employees' feelings in re-engineering their current processes, what is the complexity introduced into the system? i.e. if they have positive feelings, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.3.6 What are the customers' expectations of the e-commerce system?

High quality of service

Based on the customers' expectations, what is the complexity introduced into the system? i.e. if they have high expectations, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.3.7 What is the current level of cooperation and communication within the SME environment (i.e. employees, management)?

Very Good

Based on the level of cooperation and communication between within the SME environment, what is the complexity introduced into the system? i.e. if communication is in line, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

2 + 3. Application domain aspects and Quality Requirements

The categorization of the various types of Web applications assists in estimating their level of complexity and the development effort required.

Please identify which of the following types of web applications apply to your application and estimate the effort and complexity needed to implements each type (it could be more than

one). In addition, please list the emphasis you place on each quality requirement which applies into your application.

Types of Web Application	Please choose					Quality Requirements	Please choose				
	0	0.25	0.5	0.75	1		0	0.25	0.5	0.75	1
<i>Informational</i> Read-only content with navigation and links.					X	Usability					X
						Functionality				X	
						Reliability					X
						Efficiency					X
						Maintainability				X	
<i>Download</i> Information available for downloading by the user.	X					Usability	X				
						Functionality	X				
						Reliability	X				
						Efficiency	X				
						Maintainability	X				
<i>Customizable</i> Content can be customized based on user needs.		X				Usability		X			
						Functionality		X			
						Reliability			X		
						Efficiency		X			
						Maintainability			X		
<i>Interaction</i> Communication among users via chat rooms, bulletin boards, or instant messaging.		X				Usability		X			
						Functionality		X			
						Reliability			X		
						Efficiency			X		
						Maintainability		X			
<i>User input</i> Communication via online forms.				X		Usability			X		
						Functionality				X	
						Reliability				X	
						Efficiency			X		
						Maintainability			X		
<i>Transaction oriented</i> Order processing (products and services).				X		Usability			X		
						Functionality			X		
						Reliability				X	
						Efficiency				X	
						Maintainability			X		
<i>Service oriented</i> The application provides an online service (e.g. estimating a mortgage payment).		X				Usability		X			
						Functionality			X		
						Reliability			X		
						Efficiency		X			
						Maintainability		X			
<i>Portal</i> A starting point that channels the user to other Web applications outside the domain of the portal application.		X				Usability		X			
						Functionality		X			
						Reliability		X			
						Efficiency		X			
						Maintainability		X			
<i>Database access</i> Querying a database and retrieving information.			X			Usability			X		
						Functionality			X		
						Reliability				X	

					Efficiency			X		
					Maintainability			X		
Data warehousing Querying a collection of large databases and retrieving information.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				

5.1.1.4.4.2 Analysis

The analysis and the calculation of the mean complexity are based on the proposed formulas described in a previous section.

The first part of the questionnaire is the “Business and Organizational Issues”, which is subdivided into three key areas: Business goals, Market aspects and Human resources. The formula corresponding to the first part of the questionnaire is the following:

$$C_{1,j} = \frac{\sum_i Q_i}{i}$$

Having in mind the rating given in the questionnaire we are going to calculate the complexity associated with Business goals, Market aspects and Human resources sections respectively.

We first start with the Business Goals section. The following values are taken from the questionnaire and correspond sequentially to the rating given: 0.25, 0, 0.5, 0.5, 0.25, 0.5, 0.25, 0.25, 0.25, 0, 0. To apply the formula, we first need to add all the values and then divide by their plurality. Therefore, $C_{1,1} = 2.75/11 = 0.25$.

Dora Schabel is a company that is interested in offering its products through the internet. The pioneer work that they do in Dora Schabel will attract new customers to search for its products. The company requires that firstly an informative web application will be developed to serve the purposes of the company and at a later stage an electronic sales outlet will be complement the existing application. Time is not a critical issues, neither the budget. The management is supportive as it is one person company. In addition, the company estimates that no major re-engineering is required as the basic procedures that are available are satisfactory. Therefore the complexity of the Business goals is low, 0.25.

The values corresponding to Market aspects are: 0.25, 0.5, 0.25, 0.25, 0, 0, 0.25. With the same formula as used previously we calculate the complexity $C_{1,2} = 1.5/7 = 0.21$.

Although that there is competition from big designer names that sell expensive through stores, the hand made nature of the company makes it unique among the other companies. In addition, the company does not require a specialized ecommerce site with brand new

features/services. This is the reason so that the complexity of the market aspects is also low, 0.21.

Last area is Human resources and the associated values are: 0.25, 0.75, 0.25, 0.5, 0, 0.75, 0.25. By applying the same formula as before we have the following result $C_{1,3} = 2,75/7 = 0.39$.

The complexity for the Human resources is low to medium, 0.39. The increased complexity is due to the reason that the management and employees do not have adequate knowledge of e-business processes so they will need training. The communication level within the company is very good, so the processes are simplified and decrease complexity.

Therefore, the mean complexity value for the Business and Organizational Issues is the following: Mean complexity (BandOI) = $(0.25 + 0.25 + 0.39)/3 = 0.29$.

We continue our calculations by computing the mean complexity for the rest of the categories included in the questionnaire. First, we need to analyse Application domain ratings and then Quality requirements ratings.

The values associates with the Application domain are as follows: Informational 1, Download 0, Customizable 0.25, Interaction 0.25, User Input 0.75, Transaction oriented 0.75, Service oriented 0.25, Portal 0.25, Database access 0.5, Database warehousing 0. The average complexity for this area is associated only with the non-zero values; therefore Mean Complexity (Application domain) = $4/8 = 0.5$.

As we mentioned. Dora Schabel requires firstly an informational web application. Therefore, all the efforts are focused on developing a complete application that will offer information on the available products. Also, the company requires making considerations on using the online transaction component in the future so proper mechanisms are in placed to guarantee the success of the transactions. The user input component must be well designed as Dora Schabel is relying on the communication with the users and the relationships build between them to do business. All these requirements increased the application's domain complexity to 0.5.

The calculation of the Quality Requirements section is a bit more complex that the other sections as we first have to compute the weighted complexity of each Application domain which is associated with specific quality requirements.

We use the following formula to compute the weighted complexity (we divide the specified application domain complexity with the summation of all the application domain complexity values):

$$\hat{C}_{3,i} = C_{3,i} / \sum_j C_{3,j}$$

Where i,j is the web application types

Informational $C_{3,1} = 1/4 = 0.25$

Download $C_{3,2} = 0/4 = 0$

Customizable $C_{3,3} = 0.25/4 = 0.063$

Interaction $C_{3,4} = 0.25/4 = 0.063$

User Input $C_{3,5} = 0.75/4 = 0.188$

Transaction oriented $C_{3,6} = 0.75/4 = 0.188$

Service oriented $C_{3,7} = 0.25/4 = 0.063$

Portal $C_{3,8} = 0.25/4 = 0.063$

Database access $C_{3,9} = 0.5/4 = 0.125$

Database warehousing $C_{3,10} = 0/4 = 0$

To estimate the complexity of each quality requirement we use the following formula. The basic idea is to put the normalized values of each web application type as the weight for the contribution of the quality requirement of each type.

$$C_{2,i} = \sum_j (C_{2,i} * \hat{C}_{3,j})$$

Where i stands for the quality requirement and j stands for the web application type.

Usability $C_{2,1} = 1*0.25 + 0.25*0.063 + 0.25*0.063 + 0.5*0.188 + 0.5*0.188 + 0.25*0.063 + 0.25*0.063 + 0.5*0.125 = 0.563$

Functionality $C_{2,2} = 0.75*0.25 + 0.25*0.063 + 0.25*0.063 + 0.75*0.188 + 0.5*0.188 + 0.5*0.063 + 0.25*0.063 + 0.5*0.125 = 0.563$

Reliability $C_{2,3} = 1*0.25 + 0.5*0.063 + 0.5*0.063 + 0.75*0.188 + 0.75*0.188 + 0.5*0.063 + 0.25*0.063 + 0.75*0.125 = 0.734$

Efficiency $C_{2,4} = 1*0.25 + 0.25*0.063 + 0.5*0.063 + 0.5*0.188 + 0.75*0.188 + 0.25*0.063 + 0.25*0.063 + 0.5*0.125 = 0.625$

Maintainability $C_{2,5} = 0.75*0.25 + 0.5*0.063 + 0.25*0.063 + 0.5*0.188 + 0.5*0.188 + 0.25*0.063 + 0.25*0.063 + 0.5*0.125 = 0.516$

The Mean complexity (Quality requirements) = $3/5 = 0.6$.

The quality requirements score a higher complexity also. Dora Schabel relies on the developed informational web application to do business. Therefore, usability is vital so that people with no e-experience could easily use its website. Functionality is not a critical issue as the site will not offer specialized services at the moment. Considerations are also made for reliability, efficiency and maintainability issues as an error-free system that quickly processes requests is a necessity for a successful ecommerce application.

Table 6 - Dora Schabel Analysis

Components	Factors	
Business Assessment	Business goals	0,25
	Market aspects	0,21
	Human resources	0,39
Mean		0,29
Quality Requirements	Usability	0,563
	Functionality	0,563

	Reliability	0,734
	Efficiency	0,625
	Maintainability	0,516
Mean		0.6
Application Domain	Informational	1
	Download	0
	Customisable	0.25
	Interaction	0,25
	User Input	0.75
	Transaction oriented	0.75
	Service oriented	0,25
	Portal	0,25
	Database access	0,5
	Database warehousing	0
Mean		0,5

Finally, by using the following formula we compute the overall average complexity.

$$Av_compl = mean \left(\begin{array}{l} mean(C_{1,i}, i = 1..3) + mean(C_{2,j}, j = 1..5) \\ + mean(C_{3,k}, k = 1..8 \wedge C_{3,k} \neq 0) \end{array} \right)$$

Therefore,

$$Av_compl = (0.29 + 0.5 + 0.6) / 3 = 0.46$$

where the result is below 0.5 and short path cycle should be followed.

Appendix II – Complexity Calculations shows an excel file that was used for the calculations.

5.1.1.4.4.5 Conclusions

The company's strategic targets and goals remain the same; that is they want to be able to promote and sell exquisitely unique, high quality, richly textured, and diversely constructed, handmade, leather handbags and belts that reflect the designer's interest in the arts. At the same time, they want to give incentives to customers to buy through the Internet. This can be done by offering products in lower prices than the physical stores.

Moreover, they must automate their stock control in order to keep up with the selling's from stores plus the e-shop. Another thing they have to do is to reorganize the way they use their resources, especially technical resources; in more effective way so that they could more efficient serve their clients how place orders through Internet. Critical for the SME is to consider the way that it will deliver the products abroad.

5.1.2 Galician Implementation

The Galician methodology is based in the Cyprus one, but only a little adapted to our region needs. Since it is a general, simple and well defined methodology, it adapts well to our SMEs taxonomy and the business processes that occurs within the SME structure. Most of the

galician assessing processes were very simple, because the status of the SME, related to ICT and e-Commerce was very undeveloped.

First of all, it is recommended to start with a feasibility study, in order to see if the assessed SME has the correct infrastructure and expertise and moreover if they can describe in a detailed way all its business processes. This should aid much in the reengineering of all this processes to an e-commerce frame work.

Second, a common risks analysis (Also a SWOT analysis could be used) is used to try to find any problem or risk that could threat the e-business conversion of the SME. Usually this analysis detects two or three very common problems in any Galician SMEs (Low confidence in transactions, low internet use, infrastructure problems in rural areas ... etc).

Then the analyst should evaluate the possibilities of the SME e-upgrade. A questionnaire (used as basis the CY one) is used to provide some parameters (IT knowledge, technological development, business aims, market aspects, quality requirement ...etc) to complete the assessment and to know whether is convenient to use Short or Long Path Cycle. If the SME don't have an IT provider, the Galician LC provides the SME with a short list of its nearest IT vendors or providers (preferably Galician IT providers).

5.1.2.1 Demonstration of the proposed methodology

We apologize for the inconvenient of not providing some information related to the SMEs, because we're not allowed to provide any data or information related with any of the SMEs we gave assessment, without their allowance, as described in the Spanish Data Protection Law. Nevertheless we could describe (not in a detailed way) their activities but we can't mention their name.

5.1.2.1.1 Galician SME1

5.1.2.1.1.1 *Profile*

SME1 activities are to sell air conditioning, central heating and retailed equipment in the south region of Galicia. It has 8 employees, a turnover of 361.200€, and is a typical familiar business.

5.1.2.1.1.2 *Feasibility study*

The primary goal of this SME is to create an informational website and in the future refine and expand to an e-commerce site. This SME is a very conservative one, and think about the Internet as a good tool for promoting their business and reach new customers but, for now,

they don't want to sell any item via their website, although they are interested in keep an open door to expand to an e-commerce site in the future. Their website must be simple and modular so that they could upgrade without any major problems. Short Path Cycle fits very well for this case.

5.1.2.1.1.3 Risks identified

Since they have a well defined IT plan, we cannot consider any potential risk. Nowadays an informational website is very simple and is a must have for every SME, that keeps and open door to new potential customers. They also have the correct expertise and infrastructure.

5.1.2.1.1.4 Business reengineering assessment

This Galician SME, has a very focused picture of what they want from this website. An informational website has a low complexity, with static information and webpages. The only constraint is to select the best technology that could improve the maintenance, scalability and extendibility in a near future. That's why the business goals are low (0,25 points).

Talking about the market aspects, the punctuation is also low (0,25 points). Potential customers could use the website as a contact tool that should forward them to the physical shop/store, since they don't plan to publish a catalog of their products till next year.

The human resources score increases to 0,50, because IT are new for some of the employees although they know the Internet as common users but they don't have a business view. Only 2 of the 8 employees realize the benefits of the IT in their business logic. The site is also maintained by one of these two employees, this also adds a bit of complexity to the system.

The average of the quality requirements is low too. Usability, functionality and efficiency measurements scored 0,25 for each, because it is clear that in an informational website don't provide too much functionality, usability is important but is not very complex in an informational website and at last efficiency is related very close with performance, two low measurements in an static website (no database access or transactions).

Also the reliability is linked with the last two parameters. The score here is high because they wanted a reliable system 24x7 although it is a static system and the score should be low. It's a matter of preferences.

The maintainability scored 0,50, because they wanted to take care of the website, update basic contact info and related.

The application domain measurements:

The website, is an informational one (0,25), with no dynamic webpages or database access, with a minimum downloadable material (product brochures). The site is not customisable (at

the moment) and the interaction is very low (0,25). The user input, transaction oriented and service oriented obviously score 0 points. The portal scheme also should be 0 but they have in mind a picture of their website like a service less portal, that made us to give the 0,25.

After the evaluation of the questionnaire we obtained the Short Path Cycle as the methodology to use.

5.1.2.1.1.4.1 The questionnaire

1 Business and Organizational issues

Business and Organizational issues attempt to assess the current state of the SME; the assessment is focused on business processes and organizational issues and aims in explaining the need for change, and illustrating the desired position the SME aspires to capture via the e-commerce system. This process can reveal critical factors about the SME's organization and the business operations performed that orient the answer to the question whether the organization is ready to move to e-commerce and give indications as regards the level of the development effort needed for building a new or modifying an existing system.

Emphasis should be given on three key areas:

1.1 Business Goals

The responsibility of the analyst towards the business goals of the SME is to discover the business goals as they are defined by the management and evaluate them against the development complexity introduced into the system.

Q.1.1.1 What are the SMEs business goals in terms of extendibility, profit/budget and time limitations?.

Goals are low because they only want to approach and study the possibilities that Internet could bring to their business.

In the case where business processes are transformed in a way that they fit better to an e-business oriented environment (i.e. transform delivery/order service) what is the complexity introduced into the system? Please consider budget, expected revenue, time and effort limitations in order to assess the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.2 Is the management supportive in transforming the business to e-business? If the answer is yes, complexity could be low.

Yes, Since the management is keen on doing the e-business upgrade but the final product is an informational website. In the future they should upgrade to an e-commerce site.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.3 What will be the purpose of the developed application?

Informational and presence purposes. Nowadays, It is not very complex to design and build a simple website.

How complex is to achieve the application's purpose? i.e. in the case where the application serves informational reasons, the complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.4 What is SME's target audience? Do they have any e- experience?

The expected target audience is the Internet. They know they have to be present in this new medium. It is a strategic plan.

Based on the customers' knowledge and experience what is the complexity introduced into the system? i.e. if they are experienced complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.5 Which (current) business processes the SME would like to extend?

At the moment, the website is designed for dissemination and promotion issues. Low complexity.

How complex is to extend these business processes?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.6 Does the SME have the resources to accomplish it in terms of human resources?
Please explain.

Management is very receptive about this. They know internet and they know the advantages it could bring to them.

Having in mind your human resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.7 Does the SME have the resources to accomplish it in terms of technical resources?
Please explain.

They don't have an IT dept., so outsourcing is required here. Its IT provider is very familiarized with web environments, and they will design and build their website.

Having in mind your technical resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.8 Does the SME have the resources to accomplish it in terms of budget resources? Please explain.

They have the budget resources, and feel that the design is very important, the website must transmit their SME philosophy (although a very well defined corporative identity could increase the final price).

Having in mind your budget resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.9 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of technical limitations?

Informational website complexity is low in all terms.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.10 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of budget limitations?

Same as above, the SME has the proper budget to commit this project.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.11 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of time limitations?

Also, time limitations are not very important so complexity introduced is low.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

1.2 Market Aspects

This section aims in assessing various market aspects as competitiveness and customers' expectations, and how these issues could affect the development of the IT and e-commerce projects. Therefore, the analyst should be informed on both market and SME environment.

Q.1.2.1 What is the present market competitiveness that the SME would have to face in the specific field it is occupied?.

Market competitiveness is low because they aren't to build an e-commerce site, people is supposed to visit their website and then go to the physical store/warehouse.

In what degree competitiveness could affect the complexity of the system? i.e. if competition is high, complexity could be high too.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.2 At what degree does the management wish to compete in the target-market? Is the SME's management determined enough to dominate the target market? i.e. if the SME wishes to offer low-cost services to compete with other enterprises offering similar services it should have to find ways lowering internal costs, therefore introducing a higher complexity into the system.

Same as above

Based on the management's decision, what is the complexity introduced into the system? i.e. if the management expects to compete in a high scale then complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.3 Based on the SME's needs and expectations, do they require developing a more complex application (include other innovating features/services)?

No, they are not going to develop a complex app. Only an informational website with contact info, who we are, what we do, where we are and what customers they have.

Based on your response, what is the complexity introduced into the system? i.e. if your response is positive, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.4 How effective is the existing system compared to the old? Consider the "pre e-business" SME's business processes toward the new business processes influences by the adoption of the e-business concepts. Will the new way of doing business replace the existing one or will it work as an additional business channel?

At this moment, they won't work with an additional channel, they'll use it for promotion purposes. In the future they will think about using the website as a new business channel.

What is the complexity introduced into the system when one of the case is valid?				
Absent (0)	Low (0.25)	Medium	High (0.75)	Ultimate

		(0.5)		(1)
	X			

Q.1.2.5 What required features/services are successfully implemented and widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

Features are very easy to adopt. Their provider will take care of all.

What is the complexity introduced into the system to acquire these features/services? Having in mind that these features/services (i.e. payment gateways) are already implemented, complexity could be low if the features can easily be accessed by you.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.6 What required features/services are not widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?.

Same as above

What is the complexity introduced into the system to implement these features? Having in mind that these features may not be already implemented, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.7 What is SME's estimation about the upper time bounds needed to complete the transformation to e-business? Is there any possibility for the demands of the marketplace to shift over until the transformation is finished?.

No time limits (reasonably 2 or 3 months to finish the project)

Based on the time limits set by SME, what is the complexity introduced? Note that the smaller the time frame the higher the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

1.3 Human Resources

A vital component for the success of the e-commerce application is the human resources. This is due to the fact that complexity is introduced into the system, accordingly to employees and management behaviour and expertise.

Q.1.3.1 Is the management familiar with e-business processes?

The management promoted this project, because they feel that their business should be present in the Internet.

Based on the management's familiarity with e-business processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.2 Are the employees familiar with Internet and e-commerce transactions?.

Yes they are.

Based on the employees' familiarity with internet and e-commerce transactions, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.3 Is there an adequately trained personnel for the new processes?.

Yes, one of the managerial staff is very confident and sufficient trained for maintaing their website.

Based on the personnel's training for the new processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.3.4 Who will be maintaining the site? Is he/she knowledgeable to do so? If the answer is yes, complexity could be low.

Same as above.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.3.5 What are the employees' feelings in re-engineering their current processes?

They are very confident about using IT for promoting their business, but at the moment they don't think about the business perception.

Based on the employees' feelings in re-engineering their current processes, what is the complexity introduced into the system? i.e. if they have positive feelings, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.3.6 What are the customers' expectations of the e-commerce system?

No expectations

Based on the customers' expectations, what is the complexity introduced into the system? i.e. if they have high expectations, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.3.7 What is the current level of cooperation and communication within the SME environment (i.e. employees, management)?

A very fluent communication between them.

Based on the level of cooperation and communication between within the SME environment, what is the complexity introduced into the system? i.e. if communication is in line, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

2 + 3. Application domain aspects and Quality Requirements

The categorization of the various types of Web applications assists in estimating their level of complexity and the development effort required.

Please identify which of the following types of web applications apply to your application and estimate the effort and complexity needed to implements each type (it could be more than one). In addition, please list the emphasis you place on each quality requirement which applies into your application.

Types of Web Application	Please choose					Quality Requirements	Please choose				
	0	0.25	0.5	0.75	1		0	0.25	0.5	0.75	1
<i>Informational</i> Read-only content with navigation and links.		X				Usability		X			
						Functionality		X			
						Reliability				X	
						Efficiency		X			
						Maintainability			X		
<i>Download</i> Information available for downloading by the user.		X				Usability		X			
						Functionality		X			
						Reliability				X	
						Efficiency		X			
						Maintainability			X		
<i>Customizable</i> Content can be customized based on user needs.	X					Usability	X				
						Functionality	X				
						Reliability	X				
						Efficiency	X				
						Maintainability	X				
<i>Interaction</i> Communication among users via chat rooms, bulletin boards, or instant messaging.			X			Usability		X			
						Functionality		X			
						Reliability				X	
						Efficiency		X			
						Maintainability			X		

<i>User input</i> Communication via online forms.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Transaction oriented</i> Order processing (products and services).	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Service oriented</i> The application provides an online service (e.g. estimating a mortgage payment).	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Portal</i> A starting point that channels the user to other Web applications outside the domain of the portal application.		X			Usability		X			
					Functionality		X			
					Reliability				X	
					Efficiency		X			
					Maintainability			X		
<i>Database access</i> Querying a database and retrieving information.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Data warehousing</i> Querying a collection of large databases and retrieving information.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				

5.1.2.1.1.4.2 Analysis

First of all, we must obtain the business goals, market aspects and human resources points. Business goals scored 0,25, 0,25, 0,25, 0,5, 0,25, 0,25, 0,25, 0,25, 0,25, 0,25. Then we calculate the complexity $C1,1 = 3 / 11 = 0,272$. A low value for their expectations.

The same with market aspects and human resources, as follow:

Market Aspects = 0,25, 0,25, 0,25, 0,25, 0,25, 0,25, 0,25 where $C1,2 = 1,75 / 7 = 0,25$

Human resources = 0,25, 0,25, 0,5, 0,5, 0,5, 0,5, 0,5 where $C1,3 = 3 / 7 = 0,428$. they scored a little bit than the others because the main part of the staff are not well trained in IT.

The mean complexity of the three business assessment parameters is:

Mean = $(0,272 + 0,25 + 0,428) / 3 = 0,318$

We continue with the Application domain and Quality requirements scores:

The average complexity of the application domain aspect is linked with the non-zero values so that:

- C3,1 Informational = 0,25
- C3,3 Customisable = 0
- C3,5 User input = 0
- C3,7 Service Oriented = 0
- C3,9 Database access = 0

- C3,2 Download = 0,25
- C3,4 Interaction = 0,5
- C3,6 Transaction Oriented = 0
- C3,8 Portal = 0,25
- C3,10 Datawarehousing = 0

All of them are explained in prior sections.

Mean = $0,25 + 0,25 + 0,5 + 0,25 / 4 = 0,312$ another low complexity score.

Talking about the quality requirements , the mean value is a little more complex to calculate because each application domain is linked with all the quality requirements (like a cartesian product of two sets). We must normalize each score dividing it by the total complexity score obtained above 1,25)

The normalized complexity of each application is:

Informational C3,1 = $0,25/1,25 = 0,2$

Download C3,2 = $0,25/1,25 = 0,2$

Customisable C3,3 = $0/1,25 = 0$

Interaction C3,4 = $0,5/1,25 = 0,4$

User input C3,5 = $0/1,25 = 0$

Transaction oriented C3,6 = $0/1,25 = 0$

Service Oriented C3,7 = $0/1,25 = 0$

Portal C3,8 = $0,25/1,25 = 0,2$

Database access C3,9 = $0/1,25 = 0$

Datawarehouse C3,10 = $0/1,25 = 0$

Now it's time to estimate the complexity of each quality requirement with the formula explained in prior sections:

Usability C2,1 = $(0,25 * 0,2) + (0,25 * 0,2) + (0,25 * 0,4) + (0,25 * 0,2) = 0,25$

Functionality C2,2 = $(0,25 * 0,2) + (0,25 * 0,2) + (0,25 * 0,4) + (0,25 * 0,2) = 0,25$

Reliability C2,3 = $(0,75 * 0,2) + (0,75 * 0,2) + (0,75 * 0,4) + (0,75 * 0,2) = 0,75$

Efficiency C2,4 = $(0,25 * 0,2) + (0,25 * 0,2) + (0,25 * 0,4) + (0,25 * 0,2) = 0,25$

Maintainability C2,5 = $(0,5 * 0,2) + (0,5 * 0,2) + (0,5 * 0,4) + (0,5 * 0,2) = 0,5$

Mean complexity of the quality requirements = 0,4

Table 7 - Galician SME 1 Analysis

Components	Factors	
Business Assessment	Business goals	0,272
	Market aspects	0,25
	Human resources	0,428
Mean		0,32

Quality Requirements	Usability	0.25
	Functionality	0.25
	Reliability	0.75
	Efficiency	0.25
	Maintainability	0.38
Mean		0,376
Application Domain	Informational	0,25
	Download	0,25
	Customisable	0 (N/A)
	Interaction	0.5
	User Input	0 (N/A)
	Transaction oriented	0 (N/A)
	Service oriented	0 (N/A)
	Portal	0,25
	Database access	0 (N/A)
	Database warehousing	0 (N/A)
Mean		0,33

$$Av_compl = mean \left(\begin{array}{l} mean(C_{1,i}, i = 1..3) + mean(C_{2,j}, j = 1..5) \\ + mean(C_{3,k}, k = 1..8 \wedge C_{3,k} \neq 0) \end{array} \right)$$

Therefore,

$$Av_compl = (0.32 + 0.376 + 0.33) / 3 = 0.34$$

where the result is below 0.5 and short path cycle should be followed.

Appendix II – Complexity Calculations shows an excel file that was used for the calculations.

5.1.2.1.1.5 Conclusions

Galician SMEs are very conservative and although a website is a must for any SME, we could say this SME is very confident about Internet and the business possibilities it will rise. Short Path Cycle is used here to for assessing the SME. Only two employees have the expertise and business feelings about the benefits of the IT in its business processes, that's a very important finding. They two are the decision makers of the enterprise.

5.1.2.1.2 Galician SME2

5.1.2.1.2.1 Profile

The second one is a very important Large SME (freezed seafood). They have an e-commerce site for many preferent customers and suppliers. An ERP system is running properly. It has more than 100 employees. It is located in the south coast of Galicia.

5.1.2.1.2.2 Feasibility study

They have an IT department with a strong expertise in their sector, and needed an assessment in choosing the CRM tool that could suit perfect within their needs. They realized that a CRM tool would be desirable to improve their relationship and care with their customers and they also wanted to create a datawarehouse project in order to analyse the great amount of data generated by their customers and suppliers. This project was a very difficult one because of the systems integration complexity. These people think that reliability, efficiency and maintainability of their system is a must. Also integration between different platforms and middleware is a must too. Because of this complexity and long times in the project lifecycle, Long Path Cycle is recommended here, at first sight.

5.1.2.1.2.3 Risks identified

Integration problems are present in this analysis. The CRM and datawarehouse projects are very difficult to finish within the project deadline (there are always delays), and time is money because these two new systems are a very important part of the new business expansion plan that has to be operative by the end of 2003. This sector is very damaged since the “prestige” spill disaster, although it is recovering quickly, the business plan is very ambitious and they can't afford any mistake or delay. They are very confident about OPEN SOURCE platforms but they aren't very experienced with CRM tools in general and moreover if these tools are running in this type of platform/OS.

5.1.2.1.2.4 Business reengineering assessment

Normally this type of enterprise has the IT expertise to front this type of projects, and could be resolved with training courses but being on time (referring to the expansion plan they have to end until Dec.2003) is a critical issue, that's why they requested our help. The business goal rate is high (0,68), they expect to spend many money, but reasonably, in the new IT system and moreover in its integration within the business processes of the SME. The value chain begins in their fishing ships and ends in their customers, that's why there are complicated integration issues between different physical environments and IT systems (fish captures handling, storing in big freezers and shipping the product, respecting the freeze chain). The expansion plan aims at a high profitability but at the cost of being in the scheduled time.

The market aspects scored also a high value (0,5). They expect high revenues because they're going to low down prices. This plan ends an automatization process from the ships to the final

customer that will effect in a dramatic cost reduction. Their competitors aren't as automatized as them yet.

The human resources scored 0,5 because their IT dept. have the expertise to maintain , update and manage the system without any magor problems. The level of complexity introduced isn't very high compared to the one they have before committing this project.

The quality requirements aim high (1 point for each), like in any project with this complexity. The reliability, efficiency and maintainability are a must. They cannot afford to be stopped due to a system crash. Hardware replication, load balancing, security aspects, backups and more are very important. Money isn't matter in this type of issue and they know it. The competition in this sector is ferocious and they can't afford any error (system crash, security violations ...). Usability and functionality scored 0,5 and 0,75 each, the requisites in this two measurements aren't as high as the others.

The application domain measurements scored a high average. Customisation and download scored 0 points because this site is a transactional one with real-time info of the fresh captures. Information is the most important value here. The interaction and user input parameters have 0,5 points each. As we said information is the key, the customer only wants to see & buy. No more interaction and user data input have been taken into account. They wanted to simplify these two issues. Transactional and service oriented are another two important parameters (1 for each). They have an amount of freezed fish captures, and these captures lifecycle exists within the same day. They must sell all in the same day. Stock management in real-time is a must, they cannot order new captures to their suppliers. They are their own suppliers so that's why these two issues are important. Database access and datawarehouse with the correct datamart distribution is also linked with this two parameters (high score for both,1 point). And at last, the portal parameter scored 0,5 because they have an extranet (only for large customers) and the access is restricted to them. The services offered (accounts, credit, shipping ...) are very focused in their customer needs and aren't universal services (email, chat ...).

5.1.2.1.2.4.1 The questionnaire

1 Business and Organizational issues

Business and Organizational issues attempt to assess the current state of the SME; the assessment is focused on business processes and organizational issues and aims in explaining the need for change, and illustrating the desired position the SME aspires to capture via the e-commerce system. This process can reveal critical factors about the SME's organization and the business operations performed that orient the answer to the question whether the

organization is ready to move to e-commerce and give indications as regards the level of the development effort needed for building a new or modifying an existing system.

Emphasis should be given on three key areas:

1.1 Business Goals

The responsibility of the analyst towards the business goals of the SME is to discover the business goals as they are defined by the management and evaluate them against the development complexity introduced into the system.

Q.1.1.1 What are the SMEs business goals in terms of extendibility, profit/budget and time limitations?

Business goals are high, the budget for the project is near 500.000 Euros, and expected revenue is the most important issue. They expect to low capture prices with the total automation of their business. Also time is very important; the business plan must me completed until Dec.2003.

In the case where business processes are transformed in a way that they fit better to an e-business oriented environment (i.e. transform delivery/order service) what is the complexity introduced into the system? Please consider budget, expected revenue, time and effort limitations in order to assess the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.2 Is the management supportive in transforming the business to e-business? If the answer is yes, complexity could be low.

Yes, they are very confident about IT. They designed the strategic plan.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.3 What will be the purpose of the developed application?

Mainly it is a CRM integration project, with a part of a web application. The application complexity is high for this type of projects, with a lot of system integration.

How complex is to achieve the application's purpose? i.e. in the case where the application serves informational reasons, the complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.4 What is SME's target audience? Do they have any e- experience?

Yes, actually they have a strong relationship between their customers. Customers use their extranet to make orders and buy captures (they benefit from discounts). They quickly replaced the old method with this IT one, more profitable (cost reduction is high).

Based on the customers' knowledge and experience what is the complexity introduced into the system? i.e. if they are experienced complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.5 Which (current) business processes the SME would like to extend?

The Customer Relationship, to now what their customers want (special prices, packaging of the captures ...etc). They must introduce a new system and integrate it within their IT infrastructure. The nature of the CRM systems makes the project a bit complex.

How complex is to extend these business processes?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.6 Does the SME have the resources to accomplish it in terms of human resources?
Please explain.

Yes, they have an IT dept. well trained and with strong IT knowledge, but they aren't very experienced with CRM tools. So our aid and the CRM vendor expertise is needed here.

Having in mind your human resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.7 Does the SME have the resources to accomplish it in terms of technical resources?
Please explain.

Same as above.

Having in mind your technical resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.8 Does the SME have the resources to accomplish it in terms of budget resources?
Please explain.

Yes, budget is closed for the strategic plan of their expansion.

Having in mind your budget resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.9 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of technical limitations?

Complexity is high, but they modelled all their business processes for the previous semi-automatization they implemented. This project is the last goal to fully automatize their chain business.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.10 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of budget limitations?.

Budget limitations are important but they realized that they've done an important investment in IT. Also they don't want to spend millions in implementing the CRM.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.11 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of time limitations?.

Time is probably the most important parameter, because they must have completed their plan with no delays until Dec.2003.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

1.2 Market Aspects

This section aims in assessing various market aspects as competitiveness and customers' expectations, and how these issues could affect the development of the ecommerce application. Therefore, the analyst should be informed on both market and SME environment.

Q.1.2.1 What is the present market competitiveness that the SME would have to face in the specific field it is occupied?.

The cost reduction they expect to increase due to the introducing of this CRM system, that also complete their ambitious project of fully automatize their main business chains, should make them more competitive, and they think they will be ready to stole customers from their main competitors.

In what degree competitiveness could affect the complexity of the system? i.e. if competition is high, complexity could be high too.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.2.2 At what degree does the management wish to compete in the target-market? Is the SME's management determined enough to dominate the target market? i.e. if the SME wishes to offer low-cost services to compete with other enterprises offering similar services it should have to find ways lowering internal costs, therefore introducing a higher complexity into the system.

The main objective of their strategic plan is to lower internal costs, that will lower their final capture prices, and they feel customers will be happy to buy the same quality fish at lower prices than its competitors.

Based on the management's decision, what is the complexity introduced into the system? i.e. if the management expects to compete in a high scale then complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.2.3 Based on the SME's needs and expectations, do they require developing a more complex web application (include other innovating features/services)?.

No, they actually have an extranet that is used by the most part of their customers.

Based on your response, what is the complexity introduced into the system? i.e. if your response is positive, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.2.4 How effective is the existing system compared to the old? Consider the "pre e-business" SME's business processes toward the new business processes influences by the adoption of the e-business concepts. Will the new way of doing business replace the existing one or will it work as an additional business channel?

This new business channel is being replacing the old one but they don't want to close the other one, they want to empower this new channel while maintaining the older one for legacy purposes (which in fact is more or less the 40% of their turnover).

What is the complexity introduced into the system when one of the case is valid?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.2.5 What required features/services are successfully implemented and widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?.

Effort in time and budget issues is high.

What is the complexity introduced into the system to acquire these features/services? Having in mind that these features/services (i.e. payment gateways) are already implemented, complexity could be low if the features can easily be accessed by you.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

		X		
--	--	----------	--	--

Q.1.2.6 What required features/services are not widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

Efforts are focused in system integration, time and budget issues.

What is the complexity introduced into the system to implement these features? Having in mind that these features may not be already implemented, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.2.7 What is SME's estimation about the upper time bounds needed to complete the transformation to e-business? Is there any possibility for the demands of the IT project to shift over until the transformation is finished?

The project must be finished within the time plan described in the Strategic Expansion Plan of the SME (Deadline Dec.2003). complexity is high because of the time limit issues.

Based on the time limits set by SME or the marketplace, what is the complexity introduced? Note that the smaller the time frame the higher the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

1.3 Human Resources

A vital component for the success of the e-commerce application is the human resources. This is due to the fact that complexity is introduced into the system, accordingly to employees and management behaviour and expertise.

Q.1.3.1 Is the management familiar with e-business processes?

Yes, they promoted the expansion plan

Based on the management's familiarity with e-business processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.3.2 Are the employees familiar with Internet and e-commerce transactions?

Yes, they use internet as a work tool

Based on the employees' familiarity with internet and e-commerce transactions, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
--	--	--	--	--

Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.3.3 Is there an adequately trained personnel for the new processes?.

Yes, they have the IT expertise but have not the correct knowledge of CRM tools. This hole space must be filled with the LC and CRM vendor aid.

Based on the personnel's training for the new processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.3.4 Who will be maintaining the site? Is he/she knowledgeable to do so? If the answer is yes, complexity could be low.

The IT dept. plus the CRM vendor are to maintain the CRM system, but in the future (6 month – 1 Year) the IT dept. is going to maintain it alone.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.3.5 What are the employees' feelings in re-engineering their current processes?

They are keen on with the management decision, they will support their Strategic Plan, and also they will take an important part in the succeed of the Plan.

Based on the employees' feelings in re-engineering their current processes, what is the complexity introduced into the system? i.e. if they have positive feelings, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.3.6 What are the customers' expectations of the e-commerce system?.

Some special customers are very excited about making their orders in the extranet space reserved for this activities.

Based on the customers' expectations, what is the complexity introduced into the system? i.e. if they have high expectations, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.3.7 What is the current level of cooperation and communication within the SME environment (i.e. employees, management)?

Highly communicated.

Based on the level of cooperation and communication between within the SME environment, what is the complexity introduced into the system? i.e. if communication is in line, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

2 + 3. Application domain aspects and Quality Requirements

The categorization of the various types of Web applications assists in estimating their level of complexity and the development effort required.

Please identify which of the following types of web applications apply to your application and estimate the effort and complexity needed to implements each type (it could be more than one). In addition, please list the emphasis you place on each quality requirement which applies into your application.

Types of Web Application	Please choose					Quality Requirements	Please choose				
	0	0.25	0.5	0.75	1		0	0.25	0.5	0.75	1
<i>Informational</i> Read-only content with navigation and links.					X	Usability			X		
						Functionality				X	
						Reliability					X
						Efficiency					X
						Maintainability					X
<i>Download</i> Information available for downloading by the user.	X					Usability	X				
						Functionality	X				
						Reliability	X				
						Efficiency	X				
						Maintainability	X				
<i>Customizable</i> Content can be customized based on user needs.	X					Usability	X				
						Functionality	X				
						Reliability	X				
						Efficiency	X				
						Maintainability	X				
<i>Interaction</i> Communication among users via chat rooms, bulletin boards, or instant messaging.				X		Usability			X		
						Functionality				X	
						Reliability					X
						Efficiency					X
						Maintainability					X
<i>User input</i> Communication via online forms.				X		Usability			X		
						Functionality				X	
						Reliability					X
						Efficiency					X
						Maintainability					X
<i>Transaction oriented</i> Order processing (products and services).					X	Usability			X		
						Functionality				X	
						Reliability					X
						Efficiency					X

						Maintainability					X
<i>Service oriented</i> The application provides an online service (e.g. estimating a mortgage payment).				X		Usability			X		
						Functionality				X	
						Reliability					X
						Efficiency					X
						Maintainability					X
<i>Portal</i> A starting point that channels the user to other Web applications outside the domain of the portal application.			X			Usability			X		
						Functionality				X	
						Reliability					X
						Efficiency					X
						Maintainability					X
<i>Database access</i> Querying a database and retrieving information.					X	Usability			X		
						Functionality				X	
						Reliability					X
						Efficiency					X
						Maintainability					X
<i>Data warehousing</i> Querying a collection of large databases and retrieving information.					X	Usability			X		
						Functionality				X	
						Reliability					X
						Efficiency					X
						Maintainability					X

5.1.2.1.2.4.2 Analysis

For this case with high complexity, we must obtain the business goals, market aspects and human resources points.

The Business goals scored 0,75, 0,5, 0,75, 0,5, 0,5, 0,75, 0,75, 0,75, 0,75, 0,5, 1. Then we calculate the complexity $C1,1 = 7,5 / 11 = 0,681$

The same with market aspects and human resources, as follow:

Market Aspects = 0,5, 0,75, 0,5, 0,5, 0,5, 0,5, 0,75 where $C1,2 = 4 / 7 = 0,57$

Human resources = 0,5, 0,5, 0,5, 0,75, 0,5, 0,5, 0,25 where $C1,3 = 3,5 / 7 = 0,5$.

The mean complexity of the three business assessment parameters is:

Mean = $(0,681 + 0,57 + 0,5) / 3 = 0,583$

We continue with the Application domain and Quality requirements scores:

The average complexity of the application domain aspect is linked with the non-zero values so that:

C3,1 Informational = 1

C3,2 Download = 0

C3,3 Customisable = 0

C3,4 Interaction = 0,75

C3,5 User input = 0,75

C3,6 Transaction Oriented = 1

C3,7 Service Oriented = 1

C3,8 Portal = 0,5

C3,9 Database access = 1

C3,10 Datawarehousing = 1

All of them are explained in prior sections.

Mean = $1 + 0,75 + 0,75 + 1 + 1 + 0,5 + 1 + 1 / 8 = 0,875$ High complexity.

Talking about the quality requirements, like the other SME, the mean value is a also little more complex to calculate because each application domain is linked with all the quality requirements. We must normalize each score dividing it by the total complexity score obtained above (7)

The normalized complexity of each application is:

- | | |
|---------------------------------------|---|
| Informational C3,1 = 1 / 7 = 0,143 | Download C3,2 = 0 / 7 = 0 |
| Customisable C3,3 = 0 / 7 = 0 | Interaction C3,4 = 0,75 / 7 = 0,107 |
| User input C3,5 = 0,75 / 7 = 0,107 | Transaction oriented C3,6 = 1 / 7 = 0,143 |
| Service Oriented C3,7 = 1 / 7 = 0,143 | Portal C3,8 = 0,5 / 7 = 0,071 |
| Database access C3,9 = 1 / 7 = 0,143 | Datawarehouse C3,10 = 1 / 7 = 0,143 |

Now it's time to estimate the complexity of each quality requirement with the formula explained in prior sections:

$$\text{Usability } C2,1 = (0,5 * 0,142) + (0,5 * 0,107) + (0,5 * 0,107) + (0,5 * 0,142) + (0,5 * 0,142) + (0,5 * 0,071) + (0,5 * 0,142) + (0,5 * 0,142) = 0,5$$

$$\text{Functionality } C2,2 = (0,75 * 0,142) + (0,75 * 0,107) + (0,75 * 0,107) + (0,75 * 0,142) + (0,75 * 0,142) + (0,75 * 0,071) + (0,75 * 0,142) + (0,75 * 0,142) = 0,75$$

$$\text{Reliability } C2,3 = (1 * 0,142) + (1 * 0,107) + (1 * 0,107) + (1 * 0,142) + (1 * 0,142) + (1 * 0,071) + (1 * 0,142) + (1 * 0,142) = 1$$

$$\text{Efficiency } C2,4 = (1 * 0,142) + (1 * 0,107) + (1 * 0,107) + (1 * 0,142) + (1 * 0,142) + (1 * 0,071) + (1 * 0,142) + (1 * 0,142) = 1$$

$$\text{Maintainability } C2,5 = (1 * 0,142) + (1 * 0,107) + (1 * 0,107) + (1 * 0,142) + (1 * 0,142) + (1 * 0,071) + (1 * 0,142) + (1 * 0,142) = 1$$

Mean complexity of the quality requirements = 0,85

Table 8 - Galician SME 2 Analysis

Components	Factors	
Business Assessment	Business goals	0,681
	Market aspects	0,57
	Human resources	0,5
Mean		0,58
Quality Requirements	Usability	0,496
	Functionality	0,743
	Reliability	0,995
	Efficiency	0,995

	Maintainability	0,995
Mean		0,86
Application Domain	Informational	1
	Download	0 (N/A)
	Customisable	0 (N/A)
	Interaction	0,75
	User Input	0,75
	Transaction oriented	1
	Service oriented	1
	Portal	0,5
	Database access	1
	Database warehousing	1
Mean		0,85

$$Av_compl = mean \left(\begin{array}{l} mean(C_{1,i}, i = 1..3) + mean(C_{2,j}, j = 1..5) \\ + mean(C_{3,k}, k = 1..8 \wedge C_{3,k} \neq 0) \end{array} \right)$$

Therefore,

$$Av_compl = (0.58 + 0.86 + 0.85) / 3 = 0.76$$

where the result is above 0.5 and long path cycle should be followed.

Appendix II – Complexity Calculations shows an excel file that was used for the calculations.

5.1.2.1.2.5 Conclusions

It is very important to stay within the project timing. The technological aspect is well defined and trustworthy. They're very confident about IT systems and they know very well the advantages of them. They feel they are very competitive because of the use of IT and the final automatization of all their business processes within the main valuable chain (Frozen fish to final customer). The project is on time and they feel that they're going to have it ready and in consonance with the exploitation plan at the end of 2003.

5.1.3 Pomeranian Implementation

The Pomeranian LC realising its tasks, selected two groups of companies from all active in this region that due to their characteristics were suitable from the point of view of the document D.1.5.

The first group consisted of companies that were successful in using e-commerce. The cooperation with these companies was very close and their experience was often exploited as best practices. Small and even micro (employing only several persons) companies whose workers or owners were extremely interested in e-commerce formed the second group. Their interest was motivated by the need of reducing costs, intention of reaching new customers.

They perceived the Internet as a new quality that created new, still not fully recognised opportunities. However, they faced numerous barriers that made starting activity in this field difficult for them.

The Pomeranian LC identified these barriers and developed work methods. The methods used by the Pomeranian LC were similar to the general model described in D.1.5. The two companies selected and described in D.1.5. were representative for the two aforementioned groups. PRETOR Sp. z o.o. was the representative of the first group and ESMERALDA of the other.

5.1.3.1 Demonstration of the proposed methodology

In this section we present how the methodology worked out within the project was used in two cases researched in the Pomeranian Region. In the first case the analyst of the Pomeranian LC contacting directly with the representative of the company management analysed the company on the basis of the questionnaire worked out within the project framework. In this case it was a company already experienced in e-business and planning to develop its activity in this field. The methodology was applied to the development plans of the company. In the second case it was a company that as a result of the co-operation with Pomeranian LC became e-enabled. The company received the support in the form of training, analysis of the market and needs (SWOT) and technical assistance. The task of the LC was to support the company so that it could start its e-activity in the shortest possible time.

The way of making the analysis resulted from the methodology described in the project and the results are presented in the further part of the document.

5.1.3.1.1 Pretor Sp. z o.o.

5.1.3.1.1.1 *Companies Profile*

The company was registered in Regional Court in Gdansk 19.10.1991. The Company owners are graduates from the Technical University of Gdansk, department of Electronics, faculty of Medical Equipment. At the beginning of its activity the company ran a trading office. The changing situation on the computer market forced the company management to extend the profile of the company's activity in 1993. Thanks to that action the company was able to survive on the market in the Pomeranian Region and to work out the foundations for the company's development strategy.

Pretor offers its clients complex IT solutions for big enterprises, companies, institutions, universities and individual clients. The clients database consists of about 500 entries.

Company's activities are divided into three segments:

1. trading activities encompassing:
 - a. hardware (it is the main element deciding on the company's development; computers and servers are the main products),
 - b. standard software by Microsoft, Novel, Symantec, etc.),
2. servicing activities encompassing:
 - a. implementation,
 - b. servicing,
 - c. telecommunication,
3. manufacturing:
 - a. production of personal computers and servers PHOBOS

The present financial situation of the company is good – the company does not report any losses but records the constant growth of sales. The turnover on bank accounts are 8 digits' and the loans engagement bears over 250 000 EUROS. The computer production reaches 1000 pcs yearly and has been at this level for the last three years. According to the management's opinion the production will increase in 2003. In the previous years the production of computers reached 3000 pcs (servers and workstations) yearly. At present the company employs 15 persons, including technicians and sales persons in this number, and plans to increase the number of the employees.

Since 2002 the company has had the norm ISO 9001:2000 for manufacturing and servicing computers and servers PHOBOS.

The company aims at systematic increase of efficiency of selling process, at shortening the time of customer service and reaching a bigger number of clients. Additionally, at the beginning of 2002 the company's management worked out the plan of opening a new Internet channel of sale. The first sale through this channel took place in August 2002. This channel serviced the sale of spare parts and modules excluding the sale of company own products – computers and servers PHOBOS.

The target group that is serviced through the electronic channel consists of big and medium companies excluding the small ones or individual customers. In the previous year at the moment of this channel inauguration the company had 50 customers while presently the number amounts to over 400. The customers are serviced through the portal B2B type.

Since its beginning the company uses modern software and management systems that allow to service traditional methods of sale and production effectively.

Production of a unified product - computers and servers of PHOBOS according to ISO 9002 sold by companies co-operating within the PHOBOS Group as well as servicing customers

through the B2B type portal bizneslink.pl constitute the strategic aim of the company development.

The development plans refer to three segments of the company activities. Company places the main emphasis on including all products into the electronic channel of sale as at present the company's own products are sold in a traditional way.

The following belong to the advantages of the company:

- having a unique product on the Polish market,
- possessing full telecommunication infrastructure (the Internet servers, 21 telephone lines, fixed links),
- possessing its own web site (since January 1998),
- possessing personnel with high technical qualifications in IT field,
- implemented quality norm of ISO 9002.

5.1.3.1.1.2 Feasibility study

The company belongs to IT sector and has much expertise and experience in the field of electronic activities, which means the company technical and human resources are suitable for implementing e-commerce solutions. The company has already implemented an e-commerce system that proved to be successful in the exploitation. It also contributed to the growth of the number of customers. However, the offer accessible through the Internet does not encompass the whole range of products sold by the company. The company own products are not available in this channel of sale.

The success in gaining new customers by the means of the electronic sale made the owners consider to widen their offer and include their own products into it. The company wants to extend the offer with their computers and servers PHOBOS.

The management and the workers are interested in the e-commerce system extension. The financial situation of the company is good. There are no limitations connected with the technical resources servicing the sale system or human attitudes.

5.1.3.1.1.3 Risks identified

Although the extension of the offer itself is not difficult to implement there is a significant risk of good organisation of the post sale service and guarantee system on the country level.

5.1.3.1.1.4 Business reengineering assessment

In August 2002 the company started to run its e-commerce activity exploiting the electronic channel of sale in a very successful way proved by the significant increase of the number of

customers. The electronic sale encompassed the products offered by the company excluding their own production.

The implementation of the first stage in 2002 was conducted in a similar way to the one described as Short Process Cycle. All steps of the Analysis were performed by the management of the company who used their knowledge and market experience. Thanks to the co-operation with partners possessing a B2B platform www.bizneslink.pl the works of Engineering phase were conducted on their own as well. The next stage of the transformation toward e-commerce is planned for 2004. The company wants to conduct the works at this stage mainly with its own resources as well. The management is open to the discussion about the strategic directions and verification of organisational assumptions connected with the implementation.

Pomeranian LC supported PRETOR in the modification of the existing system. The supportive actions related to the choice of a strategic direction of activities as well as to the verification of the organisational assumptions of the implementation. The company was provided with the consulting assistance. PRETOR was also exploited as an example of the Best practice.

The information about the company PRETOR was collected at two stages: during consultations with the representatives of the company management and by the means of the direct questionnaire research.

The research was conducted by the analyst from the Pomeranian LC, who during the meeting with the representative of the company management completed the questionnaire. It was the base for collecting the information about the company and its market environment. The results of this research were analysed and presented in this document.

5.1.3.1.1.4.1 The questionnaire

1 Business and Organizational issues

Business and Organizational issues attempt to assess the current state of the SME; the assessment is focused on business processes and organizational issues and aims in explaining the need for change, and illustrating the desired position the SME aspires to capture via the e-commerce system. This process can reveal critical factors about the SME's organization and the business operations performed that orient the answer to the question whether the organization is ready to move to e-commerce and give indications as regards the level of the development effort needed for building a new or modifying an existing system.

Emphasis should be given on three key areas:

1.1 Business Goals

The responsibility of the analyst towards the business goals of the SME is to discover the business goals as they are defined by the management and evaluate them against the development complexity introduced into the system.

Q.1.1.1 What are the SMEs business goals in terms of extendibility, profit/budget and time limitations?

To increase the efficiency of the sales process through shortening of the customer service time (a bigger number of customers in the same time), to reach a bigger number of customers and to spread over a bigger area

In the case where business processes are transformed in a way that they fit better to an e-business oriented environment (i.e. transform delivery/order service) what is the complexity introduced into the system? Please consider budget, expected revenue, time and effort limitations in order to assess the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.1 Is the management supportive in transforming the business to e-business? If the answer is yes, complexity could be low.

Yes, the management fully supports the transformation and the transformation is included in the company's strategy.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.1.2 What will be the purpose of the developed web application?

To sell the IT hardware and software to a big number of users from the area of the whole country (at present the company serves 400 customers, a year ago in August 2002 when the system was started there were 50 customers – companies). The purpose of the application will be to facilitate customers obtaining the full and detailed information about the product and making a decision about the purchase. It means the application will aim at facilitating both the process of making orders and servicing the logistics process (deliveries).

How complex is to achieve the application's purpose? i.e. in the case where the application serves informational reasons, the complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.3 What is SME's target audience? Do they have any e- experience?

Polish enterprises purchasing IT products are the target audience. These companies have relatively big e-experience. 40-60% of the customer companies have experience.

Based on the customers' knowledge and experience what is the complexity introduced into the system? i.e. if they are experienced complexity could be low.

Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.4 Which (current) business processes the SME would like to extend?

The company plans to extend the sale of computers PHOBOS on the national market by the electronic means, which means to include the sale of its own products into the electronic sale channel. This extension is complex due to difficulties connected with the process of the post sale service (mainly due to the service within the guarantee period).

How complex is to extend these business processes?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.5 Does the SME have the resources to accomplish it in terms of human resources?
Please explain.

Yes – especially in the range of the post sale service (guarantee). The human resources will affect the complexity of the system.

Having in mind your human resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.6 Does the SME have the resources to accomplish it in terms of technical resources?
Please explain.

Yes.

Having in mind your technical resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.7 Does the SME have the resources to accomplish it in terms of budget resources?
Please explain.

Yes – at present but it depends on sales increase.

Having in mind your budget resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.8 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of technical limitations?

It does not require significant changes of electronic tools.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.9 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of budget limitations?

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.10 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of time limitations?

It is not a process that can be accomplished in a short time.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

1.2 Market Aspects

This section aims in assessing various market aspects as competitiveness and customers' expectations, and how these issues could affect the development of the ecommerce application. Therefore, the analyst should be informed on both market and SME environment.

Q.1.2.1 What is the present market competitiveness that the SME would have to face in the specific field it is occupied?

The competition exists on a large scale but it does not affect the complexity of the system. It can only effect in the level of prices.

In what degree competitiveness could affect the complexity of the system? i.e. if competition is high, complexity could be high too.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.2 At what degree does the management wish to compete in the target-market? Is the SME's management determined enough to dominate the target market? i.e. if the SME wishes to offer low-cost services to compete with other enterprises offering similar services it should have to find ways lowering internal costs, therefore introducing a higher complexity into the system.

The whole area of Poland is the target market, the management is determined to act widely and they do not see limitations at this stage as far as the human resources and the complexity of the system are considered. However, evaluating the real possibilities the management do not foresee the company becomes a dominant supplier of IT in Poland. Nevertheless, the management aims to the constant increase of the sales.

Based on the management's decision, what is the complexity introduced into the system? i.e. if the management expects to compete in a high scale then complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.2.3 Based on the SME's needs and expectations, do they require developing a more complex web application (include other innovating features/services)?

No.

Based on your response, what is the complexity introduced into the system? i.e. if your response is positive, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.2.4 How effective is the existing system compared to the old? Consider the "pre e-business" SME's business processes toward the new business processes influences by the adoption of the e-business concepts. Will the new way of doing business replace the existing one or will it work as an additional business channel?

The new channel of sale is even over ten times more effective. It will function as a parallel channel of sale.

What is the complexity introduced into the system when one of the case is valid?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.5 What required features/services are successfully implemented and widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

Competitors implemented successfully and use the information feature. The management does not have the knowledge about such a feature as logistics. The company will not have to place any effort on their implementation because they have already been implemented before.

What is the complexity introduced into the system to acquire these features/services? Having in mind that these features/services (i.e. payment gateways) are already implemented, complexity could be low if the features can easily be accessed by you.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.2.6 What required features/services are not widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

The possibility to serve a customer in the system by a sales person. Additionally competitors do not have such a feature as a personalisation of users who solely have an access to the

system. Moreover, the system guarantees the customer the realisation of his/her order on the following day of its making (on the condition the product is in stock).

What is the complexity introduced into the system to implement these features? Having in mind that these features may not be already implemented, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.2.7 What is SME's estimation about the upper time bounds needed to complete the transformation to e-business? Is there any possibility for the demands of the marketplace to shift over until the transformation is finished?

The assumption was made the time limit was 12 months. The changes of the system are currently implemented because the essence of this undertaking is the constant development. If the market demands changes the transformation will be accelerated.

Based on the time limits set by SME or the marketplace, what is the complexity introduced? Note that the smaller the time frame the higher the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

1.3 Human Resources

A vital component for the success of the e-commerce application is the human resources. This is due to the fact that complexity is introduced into the system, accordingly to employees and management behaviour and expertise.

Q.1.3.1 Is the management familiar with e-business processes?

Yes.

Based on the management's familiarity with e-business processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.2 Are the employees familiar with Internet and e-commerce transactions?

Yes.

Based on the employees' familiarity with internet and e-commerce transactions, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.3 Is there an adequately trained personnel for the new processes?

Yes.

Based on the personnel's training for the new processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.4 Who will be maintaining the site? Is he/she knowledgeable to do so? If the answer is yes, complexity could be low.

Yes, specialists on this domain are employed in the company.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.5 What are the employees' feelings in re-engineering their current processes?

They treat it as obtaining tools facilitating their work.

Based on the employees' feelings in re-engineering their current processes, what is the complexity introduced into the system? i.e. if they have positive feelings, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.6 What are the customers' expectations of the e-commerce system?

Customers expect full and detailed information about the offer (assistance from sales advisors). Additionally, they expect the possibility of comparing similar products and high speed of service, realisation of their order on the following day (on condition the product is in stock) and the reliability the delivery will take place in agreed time.

Based on the customers' expectations, what is the complexity introduced into the system? i.e. if they have high expectations, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

Q.1.3.7 What is the current level of cooperation and communication within the SME environment (i.e. employees, management)?

The communication is easy, due, among others, to the fact the company employs 15 persons.

Based on the level of cooperation and communication between within the SME environment, what is the complexity introduced into the system? i.e. if communication is in line, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

2 + . Application domain aspects and Quality Requirements

The categorization of the various types of Web applications assists in estimating their level of complexity and the development effort required.

Please identify which of the following types of web applications apply to your application and estimate the effort and complexity needed to implements each type (it could be more than one). In addition, please list the emphasis you place on each quality requirement which applies into your application.

Types of Web Application	Please choose					Quality Requirements	Please choose				
	0	0.25	0.5	0.75	1		0	0.25	0.5	0.75	1
<i>Informational</i> Read-only content with navigation and links.		X				Usability					X
						Functionality					X
						Reliability					X
						Efficiency		X			
						Maintainability					X
<i>Download</i> Information available for downloading by the user.	X					Usability	X				
						Functionality	X				
						Reliability	X				
						Efficiency	X				
						Maintainability	X				
<i>Customizable</i> Content can be customized based on user needs.					X	Usability				X	
						Functionality				X	
						Reliability	X				
						Efficiency	X				
						Maintainability	X				
<i>Interaction</i> Communication among users via chat rooms, bulletin boards, or instant messaging.				X		Usability					X
						Functionality					X
						Reliability	X				
						Efficiency	X				
						Maintainability	X				
<i>User input</i> Communication via online forms.		X				Usability		X			
						Functionality		X			
						Reliability	X				
						Efficiency	X				
						Maintainability	X				
<i>Transaction oriented</i> Order processing (products and services).				X		Usability			X		
						Functionality			X		
						Reliability					
						Efficiency				X	
						Maintainability			X		
<i>Service oriented</i> The application provides an online service (e.g. estimating a mortgage payment).					X	Usability					X
						Functionality				X	
						Reliability					X
						Efficiency			X		
						Maintainability	X				
<i>Portal</i> A starting point that			X			Usability			X		
						Functionality			X		

channels the user to other Web applications outside the domain of the portal application.						Reliability	X				
						Efficiency	X				
						Maintainability			X		
<i>Database access</i> Querying a database and retrieving information.					X	Usability					X
						Functionality					X
						Reliability					X
						Efficiency					X
						Maintainability					X
<i>Data warehousing</i> Querying a collection of large databases and retrieving information.	X					Usability	X				
						Functionality	X				
						Reliability	X				
						Efficiency	X				
						Maintainability	X				

5.1.3.1.1.4.2 Analysis

The following analysis is based on the answers and evaluations contained in the above questionnaire.

The formulas used in point 4.2.1 Implementation in Cyprus were used in an analogical way in the following analysis.

The first section of the questionnaire refers to the Business and Organisational Issues and is divided into three key areas: Business goals, Market aspects and Human resources.

The formula presented below was used to calculate the complexity associated with individual domains.

$$C_{1j} = \frac{\sum_i Q_i}{i}$$

The ratings corresponding to the Business goals found in the questionnaire are as follows: 0,25, 0, 0,75, 0,5, 0,75, 0,75, 0,25, 0,25, 0,25, 0,5, 0,5. Using the formula we receive the value: $C_{1,1} = 4,75/11 = 0,43$.

The worth of the Business Goals indicator of 0.43 is the consequence of significant discrepancy in the evaluation of individual goals. Thanks to this fact their character is very clear. Due to the fact all processes are critically dependent on the management's engagement the influence on the complexity evaluated with 0 means the company is managed actively. It supports the consequence in implementing changes and suggests determination in motivating and preparing the personnel, which is expressed in the evaluation the complexity with 0.75 and serious attitude to the good planning of traditional processes connected with the post sale service.

The ratings corresponding to the Market aspects found in the questionnaire are as follows: 0,25, 0,5, 0, 0,25, 0, 0,75, 0,5. The mean complexity of this area is $C_{1,2} = 2,25/7 = 0,32$.

The evaluation of Market Aspects 0.32 could suggest the underestimation of competitors but the indicator connected with the knowledge of features of own products 0.75 giving the advantage over the competition proves the good knowledge of weak points of the competition. The company is not eager to undertake quick actions, which is proved by the indicator of the evaluation of time framework for the transformation preparation equal 0.5. The drive to use simple solutions can be surprising to some extent.

The ratings corresponding to Human Resources found in the questionnaire are as follows: 0,25, 0,25, 0,25, 0,25, 0,25, 1, 0. Having used the formula we receive the mean complexity of this area: $C_{1,3} = 2,25/7 = 0,32$.

The low worth of the indicator Human Resource = 0,32 reflects the good preparation of the personnel and the evaluation is raised significantly by the importance of meeting the customers' expectations equal 1.

The Mean Complexity (Business goals and Organisational Issues) is:

$$\text{Mean} = (0,43 + 0,32 + 0,32)/3 = 0,36$$

Continuing the calculations we find complexities of other categories included in the questionnaire. The ratings corresponding to the Application Domain are as follows:

$C_{3,1}$ Informational = 0,25	$C_{3,2}$ Download = 0
$C_{3,3}$ Customisable = 1	$C_{3,4}$ Interaction = 0,75
$C_{3,5}$ User Input = 0,25	$C_{3,6}$ Transaction Oriented = 0,75
$C_{3,7}$ Service Oriented = 1	$C_{3,8}$ Portal = 0,5
$C_{3,9}$ Database access = 1	$C_{3,10}$ Database Warehousing = 0

The Mean Complexity (Application Domain) is connected only with above zero ratings and results:

$$\text{Mean} = 5,5/8 = 0,69$$

The calculation of the Quality Requirements section is a bit more complex than the other sections as we first have to normalise the complexity of each Application domain which is associated with specific quality requirements in order to use the normalised value as weight to compute the weighted average of each quality requirements.

In this case we use the formula: $\hat{C}_{3,i} = C_{3,i} / \sum_j C_{3,j}$

Where i,j is the web application types

Informational $\hat{C}_{3,1} = 0,25/5,5 = 0,045$	Download $\hat{C}_{3,2} = 0/5,5 = 0$
Customizable $\hat{C}_{3,3} = 1/5,5 = 0,182$	Interaction $\hat{C}_{3,4} = 0,75/5,5 = 0,136$
User Input $\hat{C}_{3,5} = 0,25/5,5 = 0,045$	Transaction oriented $\hat{C}_{3,6} = 0,75/5,5 = 0,136$

Service Oriented $\hat{C}_{3,7} = 1/5,5 = 0,182$

Portal $\hat{C}_{3,8} = 0,5/5,5 = 0,091$

Database access $\hat{C}_{3,9} = 1/5,5 = 0,182$

Database warehousing $\hat{C}_{3,10} = 0/5,5 = 0$

To estimate the complexity of each quality requirement we use the following formula. The basic idea is to put the normalized values of each web application type as the weight for the contribution of the quality requirement of each type.

$$C_{2,i} = \sum_j (C_{2,i} * \hat{C}_{3,j})$$

Where i stands for the quality requirement and j stands for the web application type.

Usability $C_{2,1} = 1*0,045 + 0,75*0,182 + 1*0,136 + 0,25*0,045 + 0,5*0,136 + 1*0,182 + 0,5*0,091 + 1*0,182 = 0,81$

Functionality $C_{2,2} = 1*0,045 + 0,75*0,182 + 1*0,136 + 0,25*0,045 + 0,5*0,136 + 0,75*0,182 + 0,5*0,091 + 1*0,182 = 0,76$

Reliability $C_{2,3} = 1*0,045 + 1*0,136 + 1*0,182 + 1*0,182 = 0,55$

Efficiency $C_{2,4} = 0,25*0,045 + 0,75*0,136 + 0,5*0,182 + 1*0,182 = 0,39$

Maintainability $C_{2,5} = 1*0,045 + 0,5*0,136 + 0,25*0,182 + 0,5*0,091 + 1*0,182 = 0,39$

The Mean complexity (Quality requirements) = $2,9/5 = 0,58$

The Mean evaluation of all Quality Requirements equals 0.58 and is high. The elements that could be called pragmatic such as Usability: 0,81, Functionality: 0,76 and Reliability: 0,55 that are high evaluated catch the attention.

The table below presents the summary of the values calculated in the previous section.

Table 9 - Pretor Sp. z o.o

Components	Factors	Complexity Estimation
Business Assessment	Business goals	0,43
	Market aspects	0,32
	Human resources	0,32
Mean		0,36
Quality Requirements	Usability	0,81
	Functionality	0,76
	Reliability	0,55
	Efficiency	0,39
	Maintainability	0,39
Mean		0,58
Application Domain	Informational	0,25
	Download	0 (N/A)

	Customizable	1
	Interaction	0,75
	User Input	0,25
	Transaction oriented	0,75
	Service oriented	1
	Portal	0,5
	Database access	1
	Database warehousing	0 (N/A)
Mean		0,69

$$Av_compl = mean \left(\begin{array}{l} mean(C_{1,i}, i = 1..3) + mean(C_{2,j}, j = 1..5) \\ + mean(C_{3,k}, k = 1..8 \wedge C_{3,k} \neq 0) \end{array} \right)$$

Therefore,

$$Av_compl = (0.36 + 0.58 + 0.69) / 3 = 0.54$$

Resulted Average Complexity of 0.54, which means it is close to the decision line. During the realisation of the first stage of the company transformation the model similar to the Sort Process Cycle was used but the conducted analysis indicated the Long Process Cycle use could be considered to be advised to the management of the company. The company could implement this process in its further development.

Appendix II – Complexity Calculations shows an excel file that was used for the calculations.

5.1.3.1.1.5 Conclusions

The company is experienced in the field of IT solutions. The services connected with the Internet belong to one area of the company activities. The company has had its own website since the moment of the company establishment. At the beginning the web site was used only in a passive way, which means it contained information about the products and for contacts with clients.

In 2002 the company opened its first sale channel through the Internet that was of B2B type. The undertaking was successful – within one year since the implementation of e-commerce the number of their clients had grown many times - from 50 to 400.

The company management fully supports this kind of activity. They fully realise the profits the company can make so they identified precisely conditions the company has to meet and defined them. This analysis was made so that the offer of the electronic sale can be expanded and computers and servers manufactured by the company can be sold on the national market in an electronic way.

At present the company is at the stage of preparing the organisation and resources necessary for the realisation of the second stage of transformation towards e-business.

The applied methodology worked out in the D.1.5. indicated the use of Long Process Cycle and confirmed the similar conclusions drawn by the specialists preparing the company re-engineering. Moreover, it showed also that the transformation process should be realised at stages and systematically.

5.1.3.1.2 Biuro Turystyki ESMERALDA

5.1.3.1.2.1 *Profile*

Esmeralda started its activity in April 1992 as a tour operator specialised in organising excursions to Italy. The activity of this company – a travel agency - consists in selling tourist services organised and provided by other companies. Two persons work in the company so considering the number of the employees; the company belongs to the sector of small enterprises (according to the division based on Polish legal regulations). The Internet address of the company is: www.esmeralda.gdansk.pl.

At present the agency specialises in providing services destined for the Far East. Its advantage in comparison with other competitors is the owner's long experience gained during guiding excursions organised by the biggest Polish tourist agencies, specialist vocational education and the knowledge of European and Asian countries.

The mission of the company states: "The Travel Agency means the respect for customers and providing them with professional service."

The owner of the researched SME2 has been seeking for new solutions that would allow him to develop services offered by the agency. The activity the owner found effective and wanted to implement was e-business. The lack of financial resources was the basic problem preventing the realisation of this intention. As a result of establishing contacts with the Pomeranian LC the procedure of e-business activity implementation was worked out. The owner was advised to participate in the basic course offered by this LC. Additionally, on the basis of the feasibility study and the business possibilities a customised www service for a tourist agency – an advanced tool for the management of offers and building contacts with customers was designed for this agency. The service enables the management of its content by the owner and the employee themselves.

At present the owner is preparing to do the first evaluation of the effectiveness of the new implemented solution. Due to the fact the implementation was completed in June 2003 and in the tourist industry it is the time when the sale of services finishes, the evaluation will be possible after the winter season.

5.1.3.1.2.2 *Feasibility Study*

Company is run by the person with more than 20 years experience. The owner was a travel courier in the Far East countries for many years. Her main advantage is the knowledge and experience.

That is why the owner decided to use the Internet in her selling strategy. She knows she can serve clients very well (much better than competing firms), but the number of clients is too small. Location of the company is very unfavourable. This part of the city is inhabited mainly by low-income citizens, which results in low chances to find customers among the passers-by. Implementing the Internet into the company sale strategy seems to be the only chance of its further existence on the market, of gaining market attention that can effect in the sale of the offer.

The lack of financial resources is another very important factor. The owner is well prepared to run the business on-line aware of her strengths and possibilities, but she can not afford the conditions of interactive agencies' offers. That is why she was seeking help from e-Minder project specialists.

5.1.3.1.2.3 *Risks identified*

Although the project seems to be very easy and simple, the risk involved is considered to be high. Mostly because of the cash flow situation of the company. This SME2 is straggling for the survival on the market – if the Internet sale fails the company will be close to the bankruptcy.

The Internet sale is another and completely new channel of communication with the potential clients but it can decide about the survival and development of the company. The company has to gain the critical mass of the new clients very quickly - within the period of 6 to 8 months.

The lack of financial resources has a crucial meaning in this case. Many companies with huge marketing budgets offer the same services online. The SME2 has no funds to spend on marketing, so gaining the right number of clients seems to be a hard task.

5.1.3.1.2.4 *Business reengineering assessment*

Pomeranian LC decided to use the existing methodology used in the implementation of the online strategies.

1. Interview and client's research
2. Competition research
3. Initial project and evaluation

4. Design work (graphic and programming)
5. Design evaluation and adjustments
6. Installation and testing
7. Training
8. Launching
9. Evaluation and adjustments

The methodology used by the implementing team allowed very fast work and quick results. Time was a key factor as well, due to the need of maintain the costs of the whole project at a low level.

Fast processing was also helpful and enabled to compare the assumptions with the results and to evaluate the situation.

5.1.3.1.2.4.1 The questionnaire

1 Business and Organizational issues

Business and Organizational issues attempt to assess the current state of the SME; the assessment is focused on business processes and organizational issues and aims in explaining the need for change, and illustrating the desired position the SME aspires to capture via the e-commerce system. This process can reveal critical factors about the SME's organization and the business operations performed that orient the answer to the question whether the organization is ready to move to e-commerce and give indications as regards the level of the development effort needed for building a new or modifying an existing system.

Emphasis should be given on three key areas:

1.1 Business Goals

The responsibility of the analyst towards the business goals of the SME is to discover the business goals as they are defined by the management and evaluate them against the development complexity introduced into the system.

Q.1.1.1 What are the SMEs business goals in terms of extendibility, profit/budget and time limitations?

To increase the range of the offer – so far the business has developed as a small office located in a very unfavourable part of the town. The aim is to increase the turnover and profit thanks to the increased range.

In the case where business processes are transformed in a way that they fit better to an e-business oriented environment (i.e. transform delivery/order service) what is the complexity introduced into the system? Please consider budget, expected revenue, time and effort limitations in order to assess the
--

complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.1.2 Is the management supportive in transforming the business to e-business? If the answer is yes, complexity could be low.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.3 What will be the purpose of the developed web application?

To increase the number of enquiries on-line and in a customer's office.

How complex is to achieve the application's purpose? i.e. in the case where the application serves informational reasons, the complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.4 What is SME's target audience? Do they have any e- experience?

The working persons in the age group between 30 and 50 years old, with the income higher than the state average are the target audience. They have medium e-experience.

Based on the customers' knowledge and experience what is the complexity introduced into the system? i.e. if they are experienced complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.5 Which (current) business processes the SME would like to extend?

Sale of services

How complex is to extend these business processes?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.1.6 Does the SME have the resources to accomplish it in terms of human resources? Please explain.

No. The office employs only 2 persons who are not prepared to develop the project on their own.

Having in mind your human resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

Q.1.1.7 Does the SME have the resources to accomplish it in terms of technical resources?
Please explain.

The technical resources are sufficient to do updating of offers on-line, which is one of the tasks of the application.

Having in mind your technical resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.1.8 Does the SME have the resources to accomplish it in terms of budget resources?
Please explain.

No. The company is very poor and that is the reason it seeks the assistance within the EU project. The company is interested in accomplishing the project without its financial resources engagement.

Having in mind your budget resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

Q.1.1.9 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of technical limitations?

It does not require significant changes of electronic tools.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.1.10 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of budget limitations?

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

Q.1.1.11 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of time limitations?

It is not a process that can be accomplished in a short time.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

1.2 Market Aspects

This section aims in assessing various market aspects as competitiveness and customers' expectations, and how these issues could affect the development of the ecommerce application. Therefore, the analyst should be informed on both market and SME environment.

Q.1.2.1 What is the present market competitiveness that the SME would have to face in the specific field it is occupied?

The competition is big – the company has minimal chances to success.

In what degree competitiveness could affect the complexity of the system? i.e. if competition is high, complexity could be high too.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
				X

Q.1.2.2 At what degree does the management wish to compete in the target-market? Is the SME's management determined enough to dominate the target market? i.e. if the SME wishes to offer low-cost services to compete with other enterprises offering similar services it should have to find ways lowering internal costs, therefore introducing a higher complexity into the system.

The company chooses a customer niche based on the company's specialisation in the Far East tourism (over 20 years' experience).

Based on the management's decision, what is the complexity introduced into the system? i.e. if the management expects to compete in a high scale then complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.2.3 Based on the SME's needs and expectations, do they require developing a more complex web application (include other innovating features/services)?

Yes. Customers and the market expect significantly more complex solutions but the budget and the resources (human) do not allow to develop the application.

Based on your response, what is the complexity introduced into the system? i.e. if your response is positive, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.2.4 How effective is the existing system compared to the old? Consider the "pre e-business" SME's business processes toward the new business processes influences by the adoption of the e-business concepts. Will the new way of doing business replace the existing one or will it work as an additional business channel?

The change in the activity is not significant. The change consists in the increase of the range of offers receivers and opening a new channel for contacts between a customer and the company.

What is the complexity introduced into the system when one of the case is valid?
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Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
		X		

Q.1.2.5 What required features/services are successfully implemented and widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

The application is already present on the market – at present the updating of offers on-line every 24 hours is the basic requirement of a customer.

What is the complexity introduced into the system to acquire these features/services? Having in mind that these features/services (i.e. payment gateways) are already implemented, complexity could be low if the features can easily be accessed by you.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.6 What required features/services are not widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

There are no unique solutions here. The efforts are very low due to the aforementioned reasons.

What is the complexity introduced into the system to implement these features? Having in mind that these features may not be already implemented, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.2.7 What is SME's estimation about the upper time bounds needed to complete the transformation to e-business? Is there any possibility for the demands of the marketplace to shift over until the transformation is finished?

No. The marketplace will not shift but some limitation due to seasons may occur. This does not however come in contradiction with the whole project

Based on the time limits set by SME or the marketplace, what is the complexity introduced? Note that the smaller the time frame the higher the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

1.3 Human Resources

A vital component for the success of the e-commerce application is the human resources. This is due to the fact that complexity is introduced into the system, accordingly to employees and management behaviour and expertise.

Q.1.3.1 Is the management familiar with e-business processes?

Yes

Based on the management's familiarity with e-business processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
X				

Q.1.3.2 Are the employees familiar with Internet and e-commerce transactions?

The employees' knowledge of the Internet is good and of e-commerce principles is satisfactory.

Based on the employees' familiarity with internet and e-commerce transactions, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.3.3 Is there an adequately trained personnel for the new processes?

Yes.

Based on the personnel's training for the new processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.4 Who will be maintaining the site? Is he/she knowledgeable to do so? If the answer is yes, complexity could be low.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.5 What are the employees' feelings in re-engineering their current processes?

Their attitude is very positive – they expect significant benefits connected with the changes.

Based on the employees' feelings in re-engineering their current processes, what is the complexity introduced into the system? i.e. if they have positive feelings, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

Q.1.3.6 What are the customers' expectations of the e-commerce system?

The expectations have been growing – it is possible to state that at present they are medium-high, but they grow very quickly towards high expectations.

Based on the customers' expectations, what is the complexity introduced into the system? i.e. if they have high expectations, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
			X	

Q.1.3.7 What is the current level of cooperation and communication within the SME environment (i.e. employees, management)?

Very good – mainly due to the small number of employees and a flat structure.

Based on the level of cooperation and communication between within the SME environment, what is the complexity introduced into the system? i.e. if communication is in line, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)
	X			

2 + 3. Application domain aspects and Quality Requirements

The categorization of the various types of Web applications assists in estimating their level of complexity and the development effort required.

Please identify which of the following types of web applications apply to your application and estimate the effort and complexity needed to implements each type (it could be more than one). In addition, please list the emphasis you place on each quality requirement which applies into your application.

Types of Web Application	Please choose					Quality Requirements	Please choose				
	0	0.25	0.5	0.75	1		0	0.25	0.5	0.75	1
<i>Informational</i> Read-only content with navigation and links.		X				Usability			X		
						Functionality				X	
						Reliability					X
						Efficiency		X			
<i>Download</i> Information available for downloading by the user.			X			Usability		X			
						Functionality		X			
						Reliability				X	
						Efficiency		X			
<i>Customizable</i> Content can be customized based on user needs.						Maintainability			X		
						Usability					
						Functionality					
						Reliability					
<i>Interaction</i> Communication among		X				Efficiency					
						Maintainability					
						Usability				X	
						Functionality		X			

users via chat rooms, bulletin boards, or instant messaging.					Reliability				X	
					Efficiency			X		
					Maintainability				X	
<i>User input</i> Communication via online forms.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Transaction oriented</i> Order processing (products and services).	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Service oriented</i> The application provides an online service (e.g. estimating a mortgage payment).	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Portal</i> A starting point that channels the user to other Web applications outside the domain of the portal application.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Database access</i> Querying a database and retrieving information.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				
<i>Data warehousing</i> Querying a collection of large databases and retrieving information.	X				Usability	X				
					Functionality	X				
					Reliability	X				
					Efficiency	X				
					Maintainability	X				

5.1.3.1.2.4.2 Analysis

As in the case of the other company the analysis of the complexity was made in an analogical way.

The first part of the questionnaire refers to the Business and Organisational Issues and is divided into three key areas: Business goals, Market aspects and Human resources.

The formula below was used to calculate the complexity associated with individual domains.

$$C_{1,j} = \frac{\sum_i Q_i}{i}$$

The ratings corresponding to the Business goals found in the questionnaire are as follows: 0,75, 0,25, 0,5, 0,5, 0,25, 1, 0,5, 1, 0, 1, 0,25. Using the formula we receive the value: $C_{1,1} = 6/11 = 0,55$.

The ratings corresponding to the Market aspects found in the questionnaire are as follows: 1, 0,75, 0,75, 0,5 0,25, 0,25,0. The mean complexity of this area is $C_{1,2} = 3,5/7=0,5$.

The ratings corresponding to Human Resources found in the questionnaire are as follows: 0, 0,75, 0,25, 0,25, 0,25, 0,75, 0,25. Having used the formula we receive the mean complexity of this area: $C_{1,3}=2,5/7=0,36$.

The Mean Complexity (Business goals and Organisational Issues) is:

$$\text{Mean} = (0,55 + 0,50 + 0,36)/3 = 0,47$$

Continuing the calculations we find complexities of other categories included in the questionnaire. The ratings corresponding to the Application Domain are as follows:

$$C_{3,1} \text{ Informational} = 0,25$$

$$C_{3,2} \text{ Download} = 0,5$$

$$C_{3,3} \text{ Customisable} = 0$$

$$C_{3,4} \text{ Interaction} = 0,25$$

$$C_{3,5} \text{ User Input} = 0$$

$$C_{3,6} \text{ Transaction Oriented} = 0$$

$$C_{3,7} \text{ Service Oriented} = 0$$

$$C_{3,8} \text{ Portal} = 0$$

$$C_{3,9} \text{ Database access} = 0$$

$$C_{3,10} \text{ Database Warehousing} = 0$$

The Mean Complexity (Application Domain) is connected only with above zero ratings and results:

$$\text{Mean} = 1/3 = 0,33$$

The calculation of the Quality Requirements section is a bit more complex than the other sections as we first have to normalise the complexity of each Application domain which is associated with specific quality requirements in order to use the normalised value as weight to compute the weighted average of each quality requirements.

In this case we use the formula: $\hat{C}_{3,i} = C_{3,i} / \sum_j C_{3,j}$

Where i,j is the web application types

$$\text{Informational } \hat{C}_{3,1} = 0,25/1 = 0,25 \quad \text{Download } \hat{C}_{3,2} = 0,50/1 = 0,5$$

$$\text{Customizable } \hat{C}_{3,3} = 0/1 = 0 \quad \text{Interaction } \hat{C}_{3,4} = 0,25/1 = 0,25$$

$$\text{User Input } \hat{C}_{3,5} = 0 \quad \text{Transaction oriented } \hat{C}_{3,6} = 0$$

$$\text{Service Oriented } \hat{C}_{3,7} = 0 \quad \text{Portal } \hat{C}_{3,8} = 0$$

$$\text{Database access } \hat{C}_{3,9} = 0 \quad \text{Database warehousing } \hat{C}_{3,10} = 0$$

To estimate the complexity of each quality requirement we use the following formula. The basic idea is to put the normalised values of each web application type as the weight for the contribution of the quality requirement of each type.

$$C_{2,i} = \sum_j (C_{2,i} * \hat{C}_{3,j})$$

Where i stand's for the quality requirement and j stands for the web application type.

Usability $C_{2,1} = 0,5*0,25 + 0,25*0,5 + 0,75*0,25 = 0,44$

Functionality $C_{2,2} = 0,75*0,25 + 0,25*0,5 + 0,25*0,25 = 0,38$

Reliability $C_{2,3} = 1*0,25 + 0,75*0,5 + 0,75*0,25 = 0,81$

Efficiency $C_{2,4} = 0,25*0,25 + 0,25*0,5 + 0,5*0,25 = 0,31$

Maintainability $C_{2,5} = 0,5*0,25 + 0,5*0,5 + 0,75*0,25 = 0,56$

The Mean complexity (Quality requirements) = $(0,44 + 0,38 + 0,81 + 0,31 + 0,56)/5 = 2,5/5 = 0,5$

The table below presents the summary of the values calculated in the previous section.

Table 10 - Biuro Turystyki ESMERALDA Analysis

Components	Factors	Complexity Estimation
Business Assessment	Business goals	0,55
	Market aspects	0,50
	Human resources	0,36
Mean		0,47
Quality Requirements	Usability	0,44
	Functionality	0,38
	Reliability	0,81
	Efficiency	0,31
	Maintainability	0,56
Mean		0,50
Application Domain	Informational	0,25
	Download	0,50
	Customizable	0(N/A)
	Interaction	0,25
	User Input	0(N/A)
	Transaction oriented	0(N/A)
	Service oriented	0(N/A)
	Portal	0(N/A)
	Database access	0(N/A)
	Database warehousing	0 (N/A)

Mean	0,33
------	------

$$Av_compl = mean \left(\begin{array}{l} mean(C_{1,i}, i = 1..3) + mean(C_{2,j}, j = 1..5) \\ + mean(C_{3,k}, k = 1..8 \wedge C_{3,k} \neq 0) \end{array} \right)$$

Therefore,

$$Av_compl = (0.47 + 0.5 + 0.33) / 3 = 0.43$$

where the result is below 0.5 and short path cycle should be followed.

Appendix II – Complexity Calculations shows an excel file that was used for the calculations.

5.1.3.1.2.5 Conclusions

Using the Internet strategy is a key element for this SME2 to stay on the market. The quality of the service, the excellent tourist consulting that is one of the advantages of this company, will never be used by the clients if they don't know about the company.

The owner of the company realises the situation very well. Her determination is very firm. There is a chance she can succeed, mostly thanks to her attitude toward the Internet strategy and her clients.

6. Critical issues about e-Commerce

In this section we are going to discuss issues that are important for the web engineering process and for the process of the design and implementation of an e-commerce Leveraging centre as e-MINDER. The issues discussed include: the technological infrastructure for the e-commerce/web applications, the e-commerce/web applications, web user interfaces and various security issues.

6.1 Technological Infrastructure

Technological infrastructure plays a significant role in the process of developing and implementing an e-commerce application. Since we are concerned only with web based e-commerce applications we are going to examine the technological infrastructure which is relevant only to this category of electronic commerce. By the term Technological Infrastructure we mean the web network, hosting services and payment systems. Authentication and security systems can also considered parts of the technological infrastructure. Due to the significance of these issues we are devoting paragraph 7 for analyzing these issues.

As it is well known, web based e-commerce applications use the TCP/IP protocol suite to cover the lower communication layers, and the HTTP and SSL protocol for the application layer. Although we are not going through this set of protocols, we are going to catch a glimpse of the application layer protocols and later we are going to see the characteristics for a TCP/IP network that can host web e-commerce applications.

6.1.1 The application layer protocol

6.1.1.1 HTTP: Hypertext Documents. HTTP

HTTP, Short for **HyperText Transfer Protocol**, is the Internet protocol used for transferring Web pages (described in the following section). The HTTP protocol runs in the Application Layer of the TCP/IP model shown over Transmission Control Protocol (TCP). An HTTP session begins when a client's browser requests a Web page from a remote Internet server. When the server responds by sending the page requested, the HTTP session for that object ends. Because Web pages may have many objects on them—graphics, sound or video files, frames, and so forth—each object must be requested by a separate HTTP message.

6.1.1.2 SSL: Security. SSL

SSL, (Secure Sockets Layer) is a protocol that operates between the Transport and Application Layers of TCP/IP and secures communications between the client and the server. SSL helps secure e-commerce communications and payments through a variety of techniques such as message encryption and digital signatures that we will discuss further in paragraph 7.

Web based e-commerce applications follow the above protocols / standards in order to be compatible with all web browsers and all the technologies and tools that support the development and implementation of web e-commerce applications. These technologies that are frequently used are Java, CGI, ASP, PHP etc. The tools that are usually used are Web servers or bigger platforms that combine the development and the implementation of a web e-commerce applications like IBM's Web Sphere or Microsoft e-Commerce Server. Since the purpose of this deliverable is not to discuss in detail technologies and tools used in application's layer infrastructures, a more detailed description of these technologies and tools can be found in D1.6 (Technological Evaluation).

6.1.2 Communication Layers

This section presents the network layers below the application layer that we discussed in the previous paragraph. We are referring to layers IP and TCP but we are not going to analyse

these layers because it is not in the scope of this document. We are only going to see how these layers affect the operation of an e-commerce application sitting above these layers.

It is known that the Internet entails many problems. Some of them like Bandwidth limitations, Quality of service limitations and *Network architecture limitations* have direct effects on e-commerce applications.

- *Bandwidth limitations*: There is insufficient capacity throughout the backbone, the switching centers, and most importantly, to the “last mile” to the house and small business. The result is slow service (congestion) and a very limited ability to handle video and voice traffic.
- *Quality of service limitations*: Today’s information packets take a circuitous route to get to their final destinations. This creates the phenomenon of **latency**— delays in messages caused by the uneven flow of information packets through the network. In the case of e-mail, latency is not noticeable. However, with streaming video and synchronous communication, such as a telephone call, latency is noticeable to the user and perceived as “jerkiness” in movies or delays in voice communication. Today’s Internet uses “best efforts” quality of service, (QOS), which makes no guarantees about when or whether data will be delivered, and provides each packet with the same level of service, no matter who the user is or what type of data is contained in the packet. A higher level of service quality is required if the Internet is to keep expanding into new services (such as video on demand or telephony).
- *Network architecture limitations*: Today, a thousand requests for a single music track from a central server will result in a thousand efforts by the server to download the music to each requesting client. This slows down network performance as the same music track is sent out a thousand times to clients that might be located in the same metropolitan area. This is very different from television, where the program is broadcasted once to millions of homes.

It is clear that web e-commerce applications need to be on a high available and redundant network. Additional to these two prerequisites, the web e-commerce applications have to be fast enough in execution and in network latency time in order to serve their client’s application quickly. A common way to solve this problem, is to increase the network links number or the capacity. There are also other more sophisticated approaches like content caching to the network edges (near the client), smart routing to the closest application node, mirroring, etc. All these issues will be covered in D1.6 (Technological Evaluation).

6.2 User Interface Design

Users of web documents are not interested only at information, they interact with it in novel ways that have no precedents in paper document design. The graphic user interface (GUI) of a computer system includes:

- the interaction metaphors, images and concepts used to convey function and meaning on the computer screen,
- the detailed visual characteristics of every component of the graphic interface, and
- functional sequence of interactions over time that produce the characteristic "look and feel" of Web pages and hypertext linked relationships.

Graphic design and visual "signature" graphics are not just used to "jazz up" Web pages. Graphics are an integral part of the user's experience when interacting with a web site. In interactive documents it is impossible to fully separate graphic design from issues of interface design.

6.2.1 Web pages versus conventional document design

Most of our current concepts about structuring information stem from the organization of printed books and periodicals, and the library indexing and catalogue systems that developed around printed information. The "interface standards" of books in the English-speaking world are well established and widely agreed-upon, and detailed instructions for creating books may be found in guides like *The Chicago Manual of Style*. Every feature of a book, from the table of contents to the index and footnotes has evolved over the centuries, and readers of early books faced some of the same organizational problems that the users of hypermedia documents are facing today. Gutenberg's bible of 1456 is often cited as the first modern book, yet even after the explosive growth of publishing that followed Gutenberg; it took more than 100 years for page numbering, indexes, tables of contents, and even title pages to become routine features of books. Web documents will undergo a similar evolution and standardization of the way information is organized and made available in electronic form.

6.2.2 Design precedents in print

Although networked interactive hypermedia documents do pose novel challenges to information designers, most of the guidance you need to design, create, assemble, edit, and organize multiple forms of media is not radically different from current practice in print media. Most Web documents can be made to conform to *The Chicago Manual of Style* conventions for editorial style and text organization. Most of what an organization needs to know about creating clear, comprehensive, and consistent internal publishing standards is already available in guides like the *Xerox Publishing Standards: A Manual of Style* and

Design. It is important to be careful not to get so lost in the novelty of Web pages that basic standards of editorial and graphic design get tossed aside.

6.2.3 Make your Web pages free-standing

World Wide Web pages are different from books and other documents in one crucial respect: hypertext links allow users to access a single Web page with no preamble. Thus Web pages need to be more independent than pages in a conventional book. This usually means that the headers and footers of Web pages are more informative and elaborate than printed pages. It would be absurd to repeat the copyright, author, and date of a book at the bottom of every page, but individual Web pages often need such information because a single Web page may be the only part of your site some users ever see. This problem of making documents free-standing is not unique to Web pages. Professional journals, magazines, and most newspapers repeat the date, volume, and issue numbers at the top or bottom of each printed page because they know that their readers often rip out newspaper articles or photocopy pages from journals and need that citation information to trace the original source of the article. Given these potential difficulties in creating Web sites that are both easy to use and full of complex content, the best design strategy is to consistently apply a few basic document design principles in every Web page you create. The basic elements of a document are not complicated, and have almost nothing to do with Internet technology. It's just like high school journalism class: who, what, when, and where.

6.2.3.1 Who is the Author?

Who is speaking? This question is so basic, and the information is so often taken for granted that Web authors often overlook the most fundamental piece of information a reader needs to assess the provenance of a document: who is saying this to me? Whether the page is from an individual author or an institution, always tell your reader who created the Web page. The flood of Web sites propagating incorrect or actively misleading material on the TWA Flight 800 crash offer a vivid example of how "information" of no known origin or authenticity can quickly come to dominate legitimate inquiry and discussion.

6.2.3.2 What

All documents need clear titles to capture the reader's attention, but for several reasons peculiar to the Web this basic editorial element is especially crucial. The document title is often the first thing browsers of World Wide Web documents see as the page comes up. In pages with lots of graphics the title may be the only thing the users see for several seconds as the graphics download onto the page. Additionally, the page title will become the text of a

browser "bookmark" if the user chooses to add your page to their list of URLs. A misleading or ambiguous title, or a title that contains more technical gibberish than English, will not help the user remember why they bookmarked your page.

6.2.3.3 When

Timeliness is an important element in evaluating the worth of a document. We take information about the age of most paper documents for granted: newspapers, magazines, and virtually all office correspondence are dated. So date every Web page, and change the date whenever the document is updated. This is especially important in long or complex online documents that are updated regularly, but that may not look different enough to signal a change in content to occasional readers. Corporate information, personnel manuals, product information, and other technical documents delivered as Web pages should always have revision dates.

6.2.3.4 Where

The Web is an odd "place" that has huge informational dimensions but few explicit cues to the physical location where a document originates. Click on a Web link, and you could be connected to a Web server in Sydney, Australia, Chicago, USA, or almost anywhere else with Internet connections. Unless you are well versed in parsing URLs it can be difficult to tell where a page originates. This is the World Wide Web after all, and the question of where a document came from is sometimes inseparable from who the document came from. Always tell the reader where you are from, with (if it is relevant) your corporate or institutional affiliations. Incorporating the "home" URL on at least the main pages in your site is an easy mean of maintaining the connection to where a page originated. Once the reader has saved the page as a text file or printed the page onto paper this connection may be lost. Although recent versions of the major Web browsers now allow you to automatically include the URL in anything you print, many people never take advantage of these optional features. Too many of us now have mountains of printed Web pages laying around and no easy way of re-finding the Web locations where those documents originated.

Consistently state the title, the author, the author's institutional affiliations, the revision date, and provide at least one link to a local home page in every WEB page in your system. Put the "home page" URL on a few major pages in your site. Include these basic elements and you will have gone 90% of the way toward providing your readers with an understandable Web user interface.

6.3 Security

As businesses move to take advantage of collaborative computing and electronic commerce on the Internet, data security has been a growing area of interest. Internet security is becoming an essential tool for doing business in the 21st century. Although there are undoubtedly more data security related products and services available today than ever before there are also more security related incidents each year. The rapid growth of the Internet and the constant introduction of new technologies, while creating new opportunities for businesses, also create new opportunities for intruder activity and related problems.

Security is one of the most critical areas of computing and networking-and yet one of the most commonly overlooked. Many companies build huge networks and use them for years before they start worrying about security, and they are usually prompted to do so only once a devastating security breach has taken place.

This section aims in presenting basic issues regarding security, the reasons for pursuing security along with appropriate measures we could use to protect our enterprise and assets.

6.3.1 E-commerce Requirements – What to protect

Before any attempt to secure the enterprise's network, the people involved should have a clear understanding as to what they are trying to protect and why. The requirements of the enterprise should be gathered in order to evaluate its needs and decide the measures to be taken for achieving security.

Following, we analyze the basic requirements that are needed by (almost) all the enterprises offering ecommerce services. Each enterprise, based on its needs and requirements places a different weight on each factor and takes appropriate actions for ensuring their repletion.

The basic requirements of ecommerce in respect to data security are:

- **Information confidentiality:** Confidentiality is the concept that information is available only to those who are authorized to access it. Information confidentiality is a very significant element for the security of information itself; mostly, when the information concerns customers' personal information, credit card numbers, corporation strategies etc.
- **Data integrity:** Information may be altered when it is exchanged in an insecure network, resulting in many problems. The consequences of using inaccurate information can be disastrous. If improperly modified, data can become useless, or worse, dangerous. Integrity itself ensures that information cannot be altered in unexpected way.
- **Availability:** Information can be erased or become inaccessible, resulting in loss of availability. This means that people who are authorized to get information cannot get

what they need. Availability is often the most important attribute in service-oriented businesses that depends on information.

Requirements that involve the users of the information are:

- **Authentication:** Authentication is proving that a user is whom he or she claims to be (mutual consumer and merchant authentication in the case of e-commerce). That proof may involve something the user knows (such as a password), something the user has (such as a "smartcard"), or something about the user that proves the person's identity (such as a fingerprint).
- **Authorization:** Authorization is the act of determining whether a particular user (or computer system) has the right to carry out a certain activity, such as reading a file or running a program.
- **Non-repudiation:** Security is strong when the means of authentication cannot later be refuted - the user cannot later deny that he or she performed the activity especially when he/she has been logged as such. This is very critical for ecommerce's growth. Transactions, once concluded, must be binding; neither party involved can unilaterally disavow the transaction.
- **Liability:** Neither the consumer or the merchant want liability in case of fraud that was not due to a deliberate act by them.

All these elements are at great risk in the process of doing e-commerce. When not satisfied, these requirements could pose a potential threat. These should be addressed by appropriate security measures and strategies. The next section discusses the different measures we could adopt to ensure a secure and trustworthy environment for ecommerce.

6.3.2 Security Measures for Ecommerce

Any enterprise that exercises ecommerce activities must implement a comprehensive security approach to protect its assets and systems.

6.3.2.1 Supporting Technology

An enterprise could select from a variety of commercial solutions the one that best fits its needs and requirements. Each option has different cost and security benefits and each business will need to analyze its requirements individually. Following, we analyze the security technology behind the available solutions that circulate nowadays in the market.

6.3.2.2 Firewall

The most common building block of an effective security architecture is the **firewall** approach. Firewalls constitute the first line of defense for the enterprise's interface with the

external (i.e. internet) environment in protecting private information. The Internet is a volatile and unsafe environment, therefore a firewall must be positioned to control all incoming and outgoing traffic and enhance the safeguard of the enterprise's assets from any threat that may come from the net.

6.3.2.3 Virtual Private Network

If a firewall can be described as a system used to keep the bad guys out of your network, a **Virtual Private Network** (VPN) could be described as a system used to let the good guys in. A VPN typically uses the Internet and tunneling protocols to send encrypted data from one address through the "tunnel" to the receiving address. It is implemented through software called the VPN client on the remote computer and a VPN gateway (can be part of the firewall) at the main network. It is important to note that a VPN software client user also needs a personal firewall on their system.

6.3.2.4 Intrusion Detection System

Another category of product is intrusion detection system (IDS), which can issue an alert when someone is trying to break into the network and thwart the attack. They are your eyes and ears, essential in knowing whether you are under attack. Offering both a developmental and technical perspective on this crucial element of network security, Intrusion Detection covers: practical considerations for selecting and implementing intrusion detection systems; methods of handling the results of analysis, and the options for responses to detected problems, data sources commonly used in intrusion detection and how they influence the capabilities of all intrusion detection systems; legal issues surrounding detection and monitoring that affect the design, development, and operation of intrusion detection systems. More than just an overview of the technology, Intrusion Detection presents real analysis schemes and responses, as well as a detailed discussion of the vulnerabilities inherent in many systems, and approaches to testing systems for these problems.

5.3.2.1.4 Public Key Infrastructure

E-security technologies ensure that business can be conducted online in a secure, authenticated, confidential and verifiable environment. Business is built around trust and relationships. For these to work, customers and businesses need to be sure of who they are dealing with. In the physical world, we confirm (or authenticate) people's identities using physical information. Physical checks are not possible on the Internet, so we must rely on other means to confirm identity and that the information we send and receive is not being tampered with.

Authentication technologies ensure that the transacting parties are who they claim to be. Public Key Infrastructure (PKI) belongs to this category. **Public Key Infrastructure** (PKI) ensures a secure method for exchanging information within an organization, an industry, a nation or worldwide. PKI uses digital certificates to authenticate individuals and companies. The digital certificates contain information which uniquely identifies an individual or business when using online services. This technology is being widely adopted by government agencies for online transactions. PKI makes use of a system known as **public key cryptography**, combined with carefully documented policies, to ensure that transactions are authentic and secure. Public key cryptography uses two keys to scramble and decipher messages. One key is known as a 'public key' and is widely distributed. The other is called a 'private key' and is held secretly by an individual. Messages are protected by scrambling them with the public key of the recipient. Computer algorithms ensure that only the private key held by the person you are mailing can decrypt or unscramble the message. The larger the key files involved, the higher the level of security. Digital certificates and keys provide a strong degree of security for electronic business. In a PKI system, certificates and keys are issued by Certification Authorities (CAs) under defined guidelines which ensure a high level of reliability.

The implementation of PKI requires the establishment of appropriate authorities and framework to support the PKI scheme:

- *Certification Authority*: This is the authority that will provide certification services. It may come from the public or government sector.
- *Registration Authority (optional)*: Each certification authority may involve an internal sub-authority or collaborates with an external trusted third party, called registration authority. This distinction is made when a certification authority has a lot of responsibilities and seeks to assign some of them elsewhere. The CA could send the clients' requests for a certificate to the RA; the RA will evaluate each request, investigate the profile of each applicant and inform the CA about the trusting level of the client. If the RA is not an option, the CA could perform these investigations itself.
- *Certificate Policy*: It provides rules which stipulate the criteria for issuing and using digital certificates.
- *Certificate Practice Statement*: It is a more detailed document than a Certificate Policy and concerns the actual implementation of the policy such as the protocols used etc.

- *Auditing System*: There is the need for the creation of an auditing system to evaluate the reliability and quality of the systems used, the integrity, confidentiality and availability of the data.

There is a widespread assumption that Public Key Cryptography (PKC), Public Key Infrastructure (PKI) and digital signatures will lead to a secure and reliable environment for e-commerce. Therefore, greater emphasis should be given on these issues by all interested parties.

6.3.2.5 Security Policy

Computer systems are powerful tools that touch upon many aspects of life in modern society. They can be used to enhance quality of life or degrade it. The impact of this effect may range from negligible to the dramatic.

In order to ensure that computer systems are used in an effective and productive way, it is important that the owners, operators and users of these systems have a clear understanding of acceptable standards of use. The primary step in securing an electronic commerce system is developing and implementing a dynamic document called a security policy, which identifies system aspects such as security goals and risks.

Security policies are the foundation and the bottom line of information security in an organization. A well-written and implemented policy contains sufficient information on what must be done to protect information and people in the organization. Imagine the chaos created when the security policy is barely analyzed and implemented or worst it is totally absent. The lack of the security policy constitutes a great threat to the assets of the organization especially when a security breach is activated and the appropriate procedures to resolve the problem are missing.

Throughout the security policy, it is important to establish who the authorized users might be, how they will access the system and data, how unauthorized users will be denied access, and how data will be protected within the organization as well as outside the organization. In general, thoroughly planned security policies set directions and procedures as well as define penalties and countermeasures if the policy is transgressed.

In order for a security policy to be viable for the long term, it requires a lot of flexibility based upon an architectural security concept. A security policy should be (largely) independent from specific hardware and software situations (as specific systems tend to be replaced or moved overnight). The mechanisms for updating the policy should be clearly spelled out. This includes the process, the people involved, and the people who must sign-off on the changes.

Once your security policy has been established it should be clearly communicated to users, staff, and management. Having all personnel sign a statement indicating that they have read, understood, and agreed to abide by the policy is an important part of the process. Finally, your policy should be reviewed on a regular basis to see if it is successfully supporting your security needs.

6.3.2.6 Defence in Depth Strategy

Defense in Depth is a practical strategy for achieving information assurance (IA) in today's highly networked environments. It is a practical strategy because it relies on the intelligent application of techniques and technologies that exist today. This strategy recommends a balance among protection capability, cost, performance, and operational considerations.

The Defense Information Infrastructure (DII) environment is an example of one of the U.S. Government's largest and most complex information infrastructures. The DII supports more than 2 million primary users (with extensions to an additional 2 million users). Included within the DII are some 200 command centers and 16 large data centers, the Defense Megadata Centers. The basic user environments are enclaves (physically protected facilities and compounds), incorporating more than 20,000 local networks and some 4,000 connections to a backbone network. The DII also supports more than 300,000 secure telephone users.

The DII implements a number of global virtual networks that support a range of mission functions, for example, logistics, intelligence, and using WANs such as the Joint Worldwide Intelligence Communications System (JWICS) and the Secret Internet Protocol Router Network (SIPRNet) for global connectivity. In the past, this information infrastructure was based on dedicated networks and customized information systems; today, DoD is almost totally dependent on commercial services within the Nationwide Information Infrastructure (NII) and the broader global information infrastructure.



Figure 4 - Defense in Depth Strategy

The previous figure indicates the components of the Defense in Depth Strategy. The achievement of Information Assurance requires a balanced focus on three primary elements: people, technology, and operations. Information Assurance is achieved when there is confidence that information and information systems are protected against attacks through the application of security services in such areas as availability, integrity, authentication, confidentiality, and non-repudiation. The application of these services should be based on the protect, detect, and react paradigm. This means that in addition to incorporating protection mechanisms, organizations must expect attacks and must also incorporate attack-detection tools and procedures that allow them to react to and recover from these attacks.

In implementing an effective and enduring IA capability or in adopting a Defense in Depth strategy for IA, organizations should consider:

- Taking into consideration the effectiveness of the information protection required, based on the value of the information to the organization and the potential impact that loss or compromise of the information would have on the organization's mission or business. IA decisions should be based on risk analysis and keyed to the organization's operational objectives.
- Establishing a comprehensive program of education, training, practical experience, and awareness. Professionalization and certification licensing provide a validated and recognized expert cadre of system administrators.
- Planning and following a continuous migration approach to take advantage of evolving information processing and network capabilities, both functional and security-related, and to ensure adaptability to changing organizational needs and operating environments.
- Adhering to the principles of commonality, standardization, and procedures, and interoperability and to policies.
- Using established procedures to report incident information provided by intrusion detection mechanisms to authorities and specialized analysis and response centres.

For more information on Defense in Depth Strategy, the reader should refer to the actual source http://www.iatf.net/framework_docs/version-3_1/index.cfm.

7. Conclusions

In this deliverable we present a methodology which can assist companies in becoming e-business enabled. Specifically we adopt web engineering principles and develop tools and guidelines. We demonstrate the features and generality of the methodology through its



adoption by the 3 regions represented in e-Minder that tested its viability via a number of implementation on SMEs that are already online and SMEs that are in the process of becoming e-business enabled. From our experience we expect that the proposed methodology is applicable to other regions, beyond the three represented in e-Minder and will be used as the base for the evaluation of new SMEs that need to become e-enabled by new Leveraging Centres that may wish to join the e-MINDER network, or reproduce similar Leveraging centres.

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9. Appendix I - Web Engineering Methodology Questionnaire

I. Introduction

The questionnaire aims in applying the methodology developed in D1.5 Web Engineering Methodology and Development Manual so that a decision could be taken on whether an SME should follow Short Process Cycle (SPC) or Long Process Cycle (LPC) for the development cycle process of its web application.

This questionnaire should be completed by the analyst responsible for each SME who wishes to use the e-commerce application in order to become e-enabled. The analyst is the most appropriate person to answer this questionnaire as he/she is familiar with the expectations, goals and organizational issues of the SME.

II. Instructions

Each question should be answered as clearly as possible, with enough details so that appropriate observations/conclusions could be made. A scale from 0-1 exists with the following gradation: 0 – absent, 0.25 – low, 0.5 – medium, 0.75 – high, 1 – ultimate. Each value represents a level of complexity a specific item introduces to the system. Each question is followed by a scale table. After providing your response, please select the choice that best represents your opinion on “In what degree complexity is introduced to the system in terms of the issue discussed?”. Please make sure you understand each time what each choice stands for, before answering a question. *Note that when a question is referred to a specific value i.e. high, low, it does not associate with the values of the scale table.*

III. Web Engineering Methodology

This section is based on the three categories of critical factors which are included in the proposed framework of D1.5 deliverable.

1 Business and Organizational issues

Business and Organizational issues attempt to assess the current state of the SME; the assessment is focused on business processes and organizational issues and aims in explaining the need for change, and illustrating the desired position the SME aspires to capture via the e-commerce system. This process can reveal critical factors about the SME's organization and the business operations performed that orient the answer to the question whether the organization is ready to move to e-commerce and give indications as regards the level of the development effort needed for building a new or modifying an existing system.

Emphasis should be given on three key areas:

1.1 Business Goals

The responsibility of the analyst towards the business goals of the SME is to discover the business goals as they are defined by the management and evaluate them against the development complexity introduced into the system.

Q.1.1.1 What are the SMEs business goals in terms of extendibility, profit/budget and time limitations?

In the case where business processes are transformed in a way that they fit better to an e-business oriented environment (i.e. transform delivery/order service) what is the complexity introduced into the system? Please consider budget, expected revenue, time and effort limitations in order to assess the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.1.2 Is the management supportive in transforming the business to e-business? If the answer is yes, complexity could be low.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.1.3 What will be the purpose of the developed web application?

How complex is to achieve the application's purpose? i.e. in the case where the application serves informational reasons, the complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.1.4 What is SME's target audience? Do they have any e- experience?

Based on the customers' knowledge and experience what is the complexity introduced into the system? i.e. if they are experienced complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.1.5 Which (current) business processes the SME would like to extend?

How complex is to extend these business processes?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.1.6 Does the SME have the resources to accomplish it in terms of human resources?
Please explain.

Having in mind your human resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.1.7 Does the SME have the resources to accomplish it in terms of technical resources?
Please explain.

Having in mind your technical resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.1.8 Does the SME have the resources to accomplish it in terms of budget resources?
Please explain.

Having in mind your budget resources, how complex is to achieve extendibility?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.1.9 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of technical limitations?

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.1.10 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of budget limitations?

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.1.11 What is SME's estimation about the complexity of re-engineering the business to transform it to e-business in terms of time limitations?

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

1.2 Market Aspects

This section aims in assessing various market aspects as competitiveness and customers' expectations, and how these issues could affect the development of the ecommerce application. Therefore, the analyst should be informed on both market and SME environment.

Q.1.2.1 What is the present market competitiveness that the SME would have to face in the specific field it is occupied?

In what degree competitiveness could affect the complexity of the system? i.e. if competition is high, complexity could be high too.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.2.2 At what degree does the management wish to compete in the target-market? Is the SME's management determined enough to dominate the target market? i.e. if the SME wishes to offer low-cost services to compete with other enterprises offering similar services it should have to find ways lowering internal costs, therefore introducing a higher complexity into the system.

Based on the management's decision, what is the complexity introduced into the system? i.e. if the management expects to compete in a high scale then complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.2.3 Based on the SME's needs and expectations, do they require developing a more complex web application (include other innovating features/services)?

Based on your response, what is the complexity introduced into the system? i.e. if your response is positive, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.2.4 How effective is the existing system compared to the old? Consider the "pre e-business" SME's business processes toward the new business processes influences by the adoption of the e-business concepts. Will the new way of doing business replace the existing one or will it work as an additional business channel?

What is the complexity introduced into the system when one of the case is valid?				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.2.5 What required features/services are successfully implemented and widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

What is the complexity introduced into the system to acquire these features/services? Having in mind that these features/services (i.e. payment gateways) are already implemented, complexity could be low if the features can easily be accessed by you.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.2.6 What required features/services are not widely used by others in the same or similar business market? How much effort the SME will have to place to implement these features/services?

What is the complexity introduced into the system to implement these features? Having in mind that these features may not be already implemented, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.2.7 What is SME's estimation about the upper time bounds needed to complete the transformation to e-business? Is there any possibility for the demands of the marketplace to shift over until the transformation is finished?

Based on the time limits set by SME or the marketplace, what is the complexity introduced? Note that the smaller the time frame the higher the complexity.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

1.3 Human Resources

A vital component for the success of the e-commerce application is the human resources. This is due to the fact that complexity is introduced into the system, accordingly to employees and management behaviour and expertise.

Q.1.3.1 Is the management familiar with e-business processes?

Based on the management's familiarity with e-business processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.3.2 Are the employees familiar with Internet and e-commerce transactions?

Based on the employees' familiarity with internet and e-commerce transactions, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.3.3 Are there adequately trained personnel for the new processes?

Based on the personnel's training for the new processes, what is the complexity introduced into the system? i.e. if the answer is positive, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.3.4 Who will be maintaining the site? Is he/she knowledgeable to do so? If the answer is yes, complexity could be low.

Please choose				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.3.5 What are the employees' feelings in re-engineering their current processes?

Based on the employees' feelings in re-engineering their current processes, what is the complexity introduced into the system? i.e. if they have positive feelings, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.3.6 What are the customers' expectations of the e-commerce system?

Based on the customers' expectations, what is the complexity introduced into the system? i.e. if they have high expectations, complexity could be high.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

Q.1.3.7 What is the current level of cooperation and communication within the SME environment (i.e. employees, management)?

Based on the level of cooperation and communication between within the SME environment, what is the complexity introduced into the system? i.e. if communication is in line, complexity could be low.				
Absent (0)	Low (0.25)	Medium (0.5)	High (0.75)	Ultimate (1)

2 + 3. Application domain aspects and Quality Requirements

The categorization of the various types of Web applications assists in estimating their level of complexity and the development effort required.

Please identify which of the following types of web applications apply to your application and estimate the effort and complexity needed to implements each type (it could be more than one). In addition, please list the emphasis you place on each quality requirement which applies into your application.

Types of Web Application	Please choose					Quality Requirements	Please choose				
	0	0.25	0.5	0.75	1		0	0.25	0.5	0.75	1
<i>Informational</i> Read-only content with navigation and links.						Usability					
						Functionality					
						Reliability					
						Efficiency					
						Maintainability					
<i>Download</i> Information available for downloading by the user.						Usability					
						Functionality					
						Reliability					
						Efficiency					
						Maintainability					
<i>Customizable</i> Content can be customized based on user needs.						Usability					
						Functionality					
						Reliability					
						Efficiency					
						Maintainability					
<i>Interaction</i> Communication among users via chat rooms, bulletin boards, or instant messaging.						Usability					
						Functionality					
						Reliability					
						Efficiency					
						Maintainability					
<i>User input</i> Communication via online forms.						Usability					
						Functionality					
						Reliability					
						Efficiency					
						Maintainability					
<i>Transaction oriented</i> Order processing (products and services).						Usability					
						Functionality					
						Reliability					
						Efficiency					
						Maintainability					
<i>Service oriented</i> The application provides an online service (e.g. estimating a mortgage payment).						Usability					
						Functionality					
						Reliability					
						Efficiency					
						Maintainability					
<i>Portal</i> A starting point that						Usability					
						Functionality					

channels the user to other Web applications outside the domain of the portal application.					Reliability					
					Efficiency					
					Maintainability					
<i>Database access</i> Querying a database and retrieving information.					Usability					
					Functionality					
					Reliability					
					Efficiency					
					Maintainability					
<i>Data warehousing</i> Querying a collection of large databases and retrieving information.					Usability					
					Functionality					
					Reliability					
					Efficiency					
					Maintainability					

10. Appendix II – Complexity Calculations

D1.5 Web engineering Methodology and Development Manual - Complexity Calculation Tool													
Tsiaousis One Million													
Business and Organizational Issues												Average	
Insert Business goals rating	0,75	0	0,75	1	0	0	0	0,25	0	0	0	0,25	
Insert Market Aspects rating	0,25	0,5	0,25	0	0,25	0	0,25					0,21	
Insert Human Resources rating	0	0,25	0,25	0	0,25	0,25	0,5					0,21	
Average Bussiness and organizational issues												0,23	
Application domain												Average Application Domain	
Insert values	0,25	0	0	0,5	0,25	1	0,25	0	0,25	0		0,42	
Quality Requirements													
<i>i)calculated normalized values</i>			<i>ii)calculate quality requirements complexity values</i>					<i>enter values</i>					
			Usability	Functionality	Reliability	Efficiency	Mainainability						
informational	C1,1	0,100	1	1	0,75	0,75	0,75						
download	C1,2	0,000	0	0	0	0	0						
customizable	C1,3	0,000	0	0	0	0	0						
interaction	C1,4	0,200	0,25	0,5	0,25	0,75	0,5						
user input	C1,5	0,100	0,5	0,5	0,25	0,75	0						
transaction oriented	C1,6	0,400	0,75	0,75	1	0,75	0,25						
service oriented	C1,7	0,100	0	0	0	0,5	0						
portal	C1,8	0,000	0	0	0	0	0						
database access	C1,9	0,100	0	0	0	0,5	0						
database warehousing	C1,10	0,000	0	0	0	0	0						
Average Weighted Complexity			0,500	0,550	0,550	0,700	0,275	Average Quality Requirements					0,515
Resulted Average Complexity						0,39 Cycle	SPC						

D1.5 Web engineering Methodology and Development Manual - Complexity Calculation Tool													
Top Kinisis Travel													
Business and Organizational Issues													Average
Insert Business goals rating	1	0,25	0,5	1	0,75	0,75	0,5	1	0,75	0,75	0,75	0,75	0,73
Insert Market Aspects rating	1	0,75	0,75	1	0,75	0,75	0,25						0,75
Insert Human Resources rating	0,75	0,5	0,25	0,75	0,75	1	0						0,57
Average Bussiness and organizational issues													0,68
Application domain													Average Application Domain
Insert values	0,5	0	0	0,5	0,25	1	0,25	0	0,25	0			0,46
Quality Requirements													
<i>i)calculated normalized values</i>				<i>ii)calculate quality requirements complexity values</i>					<i>enter values</i>				
				Usability	Functionality	Reliability	Efficiency	Mainainability					
informational	C1,1	0,182		1	1	1	1	1					1
download	C1,2	0,000		0	0	0	0	0					0
customizable	C1,3	0,000		0	0	0	0	0					0
interaction	C1,4	0,182		1	0,75	1	0,75	0,25					0,25
user input	C1,5	0,091		0,25	0,75	0,25	0,75	0,5					0,5
transaction oriented	C1,6	0,364		1	1	1	1	1					1
service oriented	C1,7	0,091		0,75	0,5	0,75	0,5	0,75					0,75
portal	C1,8	0,000		0,75	0,75	0,75	1	0,75					0,75
database access	C1,9	0,091		0	0	0	0	0					0
database warehousing	C1,10	0,000		0	0	0	0	0					0
Average Weighted Complexity				0,818	0,795	0,818	0,795	0,705	Average Quality Requirements				
									0,786				
Resulted Average Complexity							0,64 Cycle	LPC					

**D1.5 Web engineering Methodology and Development Manual - Complexity Calculation Tool
Objects (Pantelides Papachristodoulou Ltd)**

Business and Organizational Issues													
												Average	
Insert Business goals rating	0,5	0,25	0,5	0,25	0,5	0	0,25	0,25	0,25	0,25	0,25	0,30	
Insert Market Aspects rating	0,5	0,75	0	0	0	0	0,5					0,25	
Insert Human Resources rating	0,25	0,25	0,25	0,25	0	0,5	0,25					0,25	
Average Bussiness and organizational issues													
Application domain													
Insert values	0,5	0	0	0,25	0,25	1	0,25	0,25	0,5	0		Average Application Domain	
Quality Requirements													
<i>Calculated Normalized Values</i>			<i>Calculate Quality Requirements Complexity Values Enter Values</i>										
			Usability	Functionality	Reliability	Efficiency	Mainainability						
Informational	C1,1	0,167	0,5	0,5	0,5	0,5	0,5						
Download	C1,2	0,000	0	0	0	0	0						
Customizable	C1,3	0,000	0	0	0	0	0						
Interaction	C1,4	0,083	0,5	0,25	0,5	0,5	0,25						
User Input	C1,5	0,083	0,5	0,25	0,25	0,5	0,25						
Transaction Oriented	C1,6	0,333	1	1	1	0,75	0,75						
Service Oriented	C1,7	0,083	0,25	0,5	0,5	0,25	0,25						
Portal	C1,8	0,083	0,5	0,5	0,25	0,25	0,25						
Database access	C1,9	0,167	0,75	0,5	0,5	0,75	0,25						
Database Warehousing	C1,10	0,000	0	0	0	0	0						
			Average Weighted Complexity	0,688	0,625	0,625	0,583	0,458	Average Quality Requirements				
													0,596
						Resulted Average Complexity	0,43 Cycle	SPC					

D1.5 Web engineering Methodology and Development Manual - Complexity Calculation Tool

Dora Schabel Ltd

Business and Organizational Issues

												Average
Insert Business goals rating	0,25	0	0,5	0,5	0,25	0,5	0,25	0,25	0,25	0	0	0,25
Insert Market Aspects rating	0,25	0,5	0,25	0,25	0	0	0,25					0,21
Insert Human Resources rating	0,25	0,75	0,25	0,5	0	0,75	0,25					0,39
Average Business and organizational issues												0,29

Application domain

												Average Application Domain
Insert values	1	0	0,25	0,25	0,75	0,75	0,25	0,25	0,5	0		0,50

Quality Requirements

i)calculated normalized values

ii)calculate quality requirements complexity values enter values

			Usability	Functionality	Reliability	Efficiency	Mainainability
informational	C1,1	0,250	1	0,75	1	1	0,75
download	C1,2	0,000	0	0	0	0	0
customizable	C1,3	0,063	0,25	0,25	0,5	0,25	0,5
interaction	C1,4	0,063	0,25	0,25	0,5	0,5	0,25
user input	C1,5	0,188	0,5	0,75	0,75	0,5	0,5
transaction oriented	C1,6	0,188	0,5	0,5	0,75	0,75	0,5
service oriented	C1,7	0,063	0,25	0,5	0,5	0,25	0,25
portal	C1,8	0,063	0,25	0,25	0,25	0,25	0,25
database access	C1,9	0,125	0,5	0,5	0,75	0,5	0,5
database warehousing	C1,10	0,000	0	0	0	0	0

Average Weighted Complexity	0,563	0,563	0,734	0,625	0,516	Average Quality Requirements	0,600
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Resulted Average Complexity 0,46 Cycle SPC

D1.5 Web engineering Methodology and Development Manual - Complexity Calculation Tool

Galician SME 1

Business and Organizational Issues

													Average
Insert Business goals rating	0,25	0,25	0,25	0,5	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,27
Insert Market Aspects rating	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25					0,25
Insert Human Resources rating	0,25	0,25	0,5	0,5	0,5	0,5	0,5	0,5					0,43
Average Bussiness and organizational issues													0,32

Application domain

													Average Application Domain
Insert values	0,25	0,25	0	0,5	0	0	0	0	0,25	0	0		0,33

Quality Requirements

Calculated Normalized Values

*Calculate Quality Requirements Complexity Values
Enter Values*

			Usability	Functionality	Reliability	Efficiency	Mainainability
Informational	C1,1	0,200	0,25	0,25	0,75	0,25	0,5
Download	C1,2	0,200	0,25	0,25	0,75	0,25	0,5
Customizable	C1,3	0,000	0	0	0	0	0
Interaction	C1,4	0,400	0,25	0,25	0,75	0,25	0,2
User Input	C1,5	0,000	0	0	0	0	0
Transaction Oriented	C1,6	0,000	0	0	0	0	0
Service Oriented	C1,7	0,000	0	0	0	0	0
Portal	C1,8	0,200	0,25	0,25	0,75	0,25	0,5
Database access	C1,9	0,000	0	0	0	0	0
Database Warehousing	C1,10	0,000	0	0	0	0	0

Average Weighted Complexity	0,250	0,250	0,750	0,250	0,380	Average Quality Requirements	0,376
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Resulted Average Complexity 0,34 Cycle SPC

D1.5 Web engineering Methodology and Development Manual - Complexity Calculation Tool
Galician SME 2

Business and Organizational Issues

													Average
Insert Business goals rating	0,75	0,5	0,75	0,5	0,5	0,75	0,75	0,75	0,75	0,75	0,5	1	0,68
Insert Market Aspects rating	0,5	0,75	0,5	0,5	0,5	0,5	0,75						0,57
Insert Human Resources rating	0,5	0,5	0,5	0,75	0,5	0,5	0,25						0,50
Average Bussiness and organizational issues													0,58

Application domain

Insert values	1	0	0	0,75	0,75	1	1	0,5	1	1			Average Application Domain	0,86
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Quality Requirements

Calculated Normalized Values

Calculate Quality Requirements Complexity Values
Enter Values

			Usability	Functionality	Reliability	Efficiency	Mainainability		
Informational	C1,1	0,143	0,5	0,75	1	1	1		
Download	C1,2	0,000	0	0	0	0	0		
Customizable	C1,3	0,000	0	0	0	0	0		
Interaction	C1,4	0,107	0,5	0,75	1	1	1		
User Input	C1,5	0,107	0,5	0,75	1	1	1		
Transaction Oriented	C1,6	0,143	0,5	0,75	1	1	1		
Service Oriented	C1,7	0,143	0,5	0,75	1	1	1		
Portal	C1,8	0,071	0,5	0,75	1	1	1		
Database access	C1,9	0,143	0,5	0,75	1	1	1		
Database Warehousing	C1,10	0,143	0,5	0,75	1	1	1		
		Average Weighted Complexity	0,500	0,750	1,000	1,000	1,000	Average Quality Requirements	0,850
					Resulted Average Complexity	0,76 Cycle	LPC		

D1.5 Web engineering Methodology and Development Manual - Complexity Calculation Tool

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Business and Organizational Issues

													Average
Insert Business goals rating	0,25	0	0,75	0,5	0,75	0,75	0,25	0,25	0,25	0,5	0,5	0,5	0,43
Insert Market Aspects rating	0,25	0,5	0	0,25	0	0,75	0,5						0,32
Insert Human Resources rating	0,25	0,25	0,25	0,25	0,25	1	0						0,32
Average Bussiness and organizational issues													0,36

Application domain

													Average Application Domain
Insert values	0,25	0,00	1	0,75	0,25	0,75	1	0,5	1	0			0,69

Quality Requirements

Calculated Normalized Values

*Calculate Quality Requirements Complexity Values
Enter Values*

			Usability	Functionality	Reliability	Efficiency	Mainainability
Informational	C1,1	0,045	1	1	1	0,25	1
Download	C1,2	0,000	0	0	0	0	0
Customizable	C1,3	0,182	0,75	0,75	0	0	0
Interaction	C1,4	0,136	1	1	0	0	0
User Input	C1,5	0,045	0,25	0,25	0	0	0
Transaction Oriented	C1,6	0,136	0,5	0,5	1	0,75	0,5
Service Oriented	C1,7	0,182	1	0,75	1	0,5	0,25
Portal	C1,8	0,091	0,5	0,5	0	0	0,5
Database access	C1,9	0,182	1	1	1	1	1
Database Warehousing	C1,10	0,000	0	0	0	0	0

Average Weighted Complexity	0,81	0,76	0,55	0,39	0,39	Average Quality Requirements	0,58
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Resulted Average Complexity 0,54 Cycle LPC

D1.5 Web engineering Methodology and Development Manual - Complexity Calculation Tool

ESMERALDA

Business and Organizational Issues

													Average
Insert Business goals rating	0,75	0,25	0,5	0,5	0,25	1	0,5	1	0	1	0,25	0,55	
Insert Market Aspects rating	1	0,75	0,75	0,5	0,25	0,25	0					0,50	
Insert Human Resources rating	0	0,75	0,25	0,25	0,25	0,75	0,25					0,36	
Average Bussiness and organizational issues												0,47	

Application domain

													Average Application Domain
Insert values	0,25	0,50	0	0,25	0	0	0	0	0	0	0	0	0,33

Quality Requirements

Calculated Normalized Values

Calculate Quality Requirements Complexity Values

Enter Values

			Usability	Functionality	Reliability	Efficiency	Mainainability	
Informational	C1,1	0,250	0,5	0,75	1	0,25	0,5	
Download	C1,2	0,500	0,25	0,25	0,75	0,25	0,5	
Customizable	C1,3	0,000	0	0	0	0	0	
Interaction	C1,4	0,250	0,75	0,25	0,75	0,5	0,75	
User Input	C1,5	0,000	0	0	0	0	0	
Transaction Oriented	C1,6	0,000	0	0	0	0	0	
Service Oriented	C1,7	0,000	0	0	0	0	0	
Portal	C1,8	0,000	0	0	0	0	0	
Database access	C1,9	0,000	0	0	0	0	0	
Database Warehousing	C1,10	0,000	0	0	0	0	0	
Average Weighted Complexity			0,44	0,38	0,81	0,31	0,56	Average Quality Requirements
							0,500	

Resulted Average Complexity 0,43 Cycle SPC