

On the Electronic Collaboration of SMEs: A Case Study

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Abstract

For Small and Medium sized Enterprises (SMEs) the establishment of business relationships and collaborations is becoming increasingly important in the face of market globalisation. These collaborations consist of identifying possible partners (e.g. clients or suppliers), providing them with appropriate information, setting up a common environment for communication and finally starting commercial operations. Until the early 90's, the limited resources SMEs could allocate for such purposes significantly undermined the efficiency of the collaboration. However, recent advances in technology, including the rapid increase of the use of the Internet, suggest that an efficient and cost-effective collaboration between SMEs is possible. In this paper, we present our experiences gained from a number of EU funded projects related to SMEs in Greece and other member-countries of the EU and propose a framework for strengthening efficient collaboration between SMEs. Within this framework both technical and managerial aspects are addressed.

1. Introduction

Electronic commerce (EC) may be defined as the use of electronic means to exchange information and to execute transactions in a commercial environment. For Small and Medium sized Enterprises (SMEs) three EC areas may be distinguished:

- Business-to-consumer
- Business-to-business
- Business-to-administration

From these areas, business-to-business EC represents a huge potential market with better current growth prospects than the other two [1].

Business-to-business EC goes beyond just Electronic Data Interchange (EDI) and covers all business processes.

This is now possible due to the wide-use and low-cost of the Internet as the main technological platform. This new situation provides a number of opportunities for SMEs.

In this paper, we present our experiences gained from a number of projects related to SMEs in Greece, which as recent statistics indicate, take up a large sector of the economy; the number of SMEs in Greece reaches 508.000, the vast majority of which (~ 96%) employ less than 10 persons. The need for Internet-based tools to assist the establishment of business relationships and the collaboration between SMEs is clear, and our experiences from the development of such an application are presented in the following sections.

This paper is organised as follows. In Section 2 we present the results from two surveys that allowed us to determine the requirements and feasibility of the suggested EC application. The feasibility study includes the technological level of SMEs, their collaboration needs and their intentions to invest on such systems. In Section 3 we present the application from a user's as well as a developer's perspective. The user's perspective includes the components of the application, while the developer's perspective includes the technological issues faced and the reasoning behind the final selections. In Section 4 we present a variation of the application that can be installed in each individual enterprise and suggest a methodology for the business process transformation needed. Finally, in Section 5 we present the concluding remarks and identify future work in the area.

2. User Requirements

The requirements of Greek SMEs for collaboration were determined in two surveys. The first was conducted by the consulting firm Advanced Services Group, Ltd. (ASG) in the context of the SARBA project [2] (ORA Programme). In Greece, the administrative area covered by the project was Peloponnesse. The survey was

structured in two distinct phases. Initially, postal questionnaires (a total of 2000 for all the regions covered by the SARBA consortium) were used to convey the rationale of the project to companies, record their telematic infrastructure and collect some first ideas on the applications that would best match their needs. At a later stage, face-to-face detailed interviews were organised to specify in more detail the pursued applications. In this last stage of the survey, the software engineering method of prototyping [3] was adopted as a means to collect accurate information on the targeted systems.

Some key findings for the Peloponnese area: the requirements survey indicated that the majority of firms were privately-owned and engaged in manufacturing, agro-food and services' operations. Their main problems included lack of information to support their management decisions, problems in their communication with suppliers/clients or other bodies, transport difficulties and availability of qualified personnel (technical and administrative) in their location. Firms presented a wide range of in-site operations but a significant part of them were operating as production/storage units leaving their offices in Athens or in other urban centers to take care of marketing and sales. Networks of customers and suppliers were both found to be extensive in the majority of firms and almost half of these were selling exclusively to other businesses/ organisations. Investigation on the use of I.T/Telecommunication equipment and services indicated the extensive use of telephone and telefax for business transactions as well as a very significant base of PC users (74% of the responses in postal survey). Computer-supported applications widely used by firms are mainly related to administration (word processing, payroll, etc.), accounting and sales. Training of personnel takes place either through self-teaching or guidance from colleagues. Finally, 43% of companies are willing to proceed with full integration of their existing procedures, while 16% are capable of accommodating a full re-engineering process. A more detailed discussion on the findings of the survey in the Peloponnese area can be found in [4].

These results were also justified in a survey carried out by NCSR "Demokritos" in the context of the SMARTS/ACTS project (<http://www.smarts.gr>).

3. The ERBC Application

The Greek application developed by ASG in the context of the ORA/SARBA project was named ERBC. ERBC is the acronym for Electronic Register for Business Co-operation. ERBC aimed to effectively address the information needs of rural SMEs by providing the means

for their communication and establishment of business partnerships. ERBC can be used to provide precise and low cost information to SMEs that do not have the resources to promote their products/services and, presently, seek partnerships through traditional channels. The main modules of ERBC, structured in accordance to the above stated pursuits, are: a Business Directory (BD), a Product/Services Catalogue (PSC), an Electronic Noticeboard (EN), a business-to-business Matching Mechanism (MM) and a multimedia Mailing System (MS). Structured in this way, ERBC supports all the stages for the establishment of business-to-business relationships (Figure 1) namely the identification of potential partners, the acquisition of information on the potential partner and finally the establishment of communication between the involved enterprises.

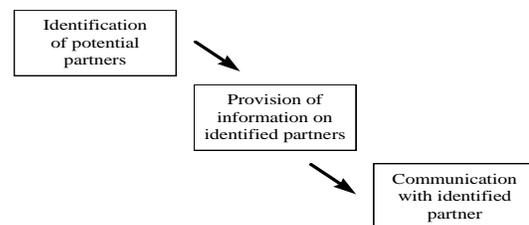


Figure 1. ERBC supports business-to-business collaboration establishment

Identification of potential partners is handled through the MM, provision of further information on them is realised through the BD and PSC, while the exchange of information is feasible through the MS module.

The main characteristics of the most important ERBC modules, in brief, are:

- **Business Directory:** This module provides users with analytical company profiles and brief presentations of associated information like departments, contact persons, product - service listings, etc. Each company may store already published fiscal information (turnover, fixed assets, exports, etc.) covering recent years of its activity. Company profiles may have unstructured information associated to them, with the capability of incorporating images. The variety of structured information stored for each company allows the user to query for companies that satisfy any combination of more than 20 criteria ranging from legal status and establishment date to export countries and fiscal data.
- **Products/Services Catalogue:** Information on products/services can be obtained under this module. This information is divided into structured and unstructured. Unstructured information may contain text, images and/or video. Structured information ranges from company and contact persons to price and delivery period (wherever applicable). This

information also includes a number of attributes that characterise the category of products/services as well as the values of these attributes. These attributes are different for different products/services categories e.g. for the product category 'shoes' candidate attributes are size, colour, material etc. whereas for the service category 'house rental' candidate attributes include number of rooms, availability, garage etc. The user may query for products and/or services by category. Additionally, she may further refine her query by selecting a value for each category's attribute. For example, the user may query for shoes and then limit her search to black, formal shoes, size 38. After the list of services or products is derived, she may easily switch to the business directory and obtain company related information, or she may switch to the electronic noticeboard and obtain the announcements associated to a specific product/service.

- Matching Mechanism:** The main mechanism provided by ERBC, for effective support of business cooperations' development, is the Matching Mechanism. Companies registered within the system's database may submit collaboration profiles, indicating the type of partner sought, the kind of pursued collaboration, the areas/sectors of interest, etc. Collaboration specification covers geographical information, size of firms etc. ERBC allows the on-line manipulation of such information. Complicated queries match the submitted collaboration profiles to registered companies (Figure 2) and produce the relative reports for interested users. The matching process takes into account all relative database information as well as the profiles of both interested companies. Notification of firms for profiles' successful matches is performed automatically, upon subsystem's invocation.

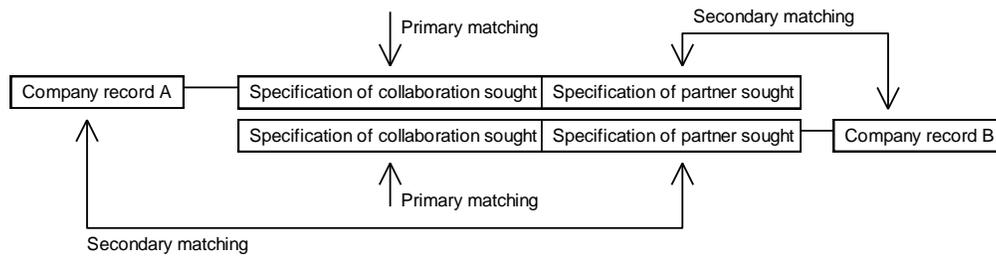


Figure 2. ERBC Business Matching Mechanism

- Electronic Noticeboard:** This module allows ERBC users to submit a note in a space that every other subscriber can access (a software implementation of the concept of a Noticeboard). These notices can include both text (e.g. announcements, advertisements, etc.) and images (e.g. technical drawings, product photos, etc.). When submitting a notice, the user may associate it to a company, one or more products/services categories, one or more specific

product/service, and up to four keywords. Other users may subsequently use these associated informations when querying for notices.

The basic Entity-relationship Model (ERM) for the BD, PSC and MM modules is illustrated in Figure 3. The ERM illustrates the relationships between basic information entities (implemented as files in the respective database) as well as their cardinalities.

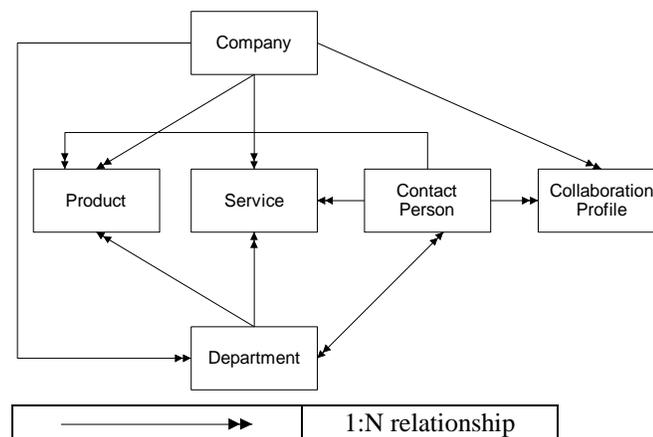




Figure 3. Basic Entity - Relationship model for ERBC application

To broaden the scope of the above business-to-business application, ERBC has been structured as a multilingual system. The multilingual character refers to both the user interface (UI) and the underlying database feeding the system with information (i.e. efficient duplication of UIs and databases).

3.2.1 Technical information on ERBC

Technically, the ERBC was initially based on proprietary client/server architecture. Provision was taken to minimise the cost that should be incurred by the end-user. In this respect, ASG employed a multimedia authoring environment (TouchVision's MicroGuide) which, in the context of SARBA, was enriched with telecommunication capabilities. Users needed to dial-up to a central host where the actual database was installed and operated. The database was hosted by the Informix RDBMS. The communication between the client and server was based on a proprietary protocol which was designed taking into account the peculiarities of the multimedia front-end. At the user's site a relatively small number of pre-programmed "templates" was installed to expedite the involved communication. Data fetched by the central host were merged with the template encapsulated information and presented to the user.

The architecture was quite limiting and lacked conformance to well-established and constantly emerging standards like the WWW [5] and TCP [6]. The great boost that the WWW recognised since 1994 rendered the adaptation of the ERBC telematic application to this Internet service a necessity. The adaptation of the application was realised in the context of the RegioNet project (<http://www.regionet.org>), which in turn was implemented in the framework of the Telematic Application Programme (TAP). The basic database schema was preserved but the user interface was entirely re-designed to comply with the HTML and URL standards. Interaction with the RDBMS was accomplished through the wide-spread Common Gateway Interface [7]. Small and concise applications were programmed in C using static SQL (embedded SQL) or the dynamic SQL API that X/Open compliant contemporary RDBMSs offer. Alternative technical scenarios were investigated (e.g. ODBC, ISAPI, NSAPI) in the context of an extensive technologies survey [8].

4. On-site Installation

Apart from the initially developed, on-line service version of ERBC, the continuously evolving needs of Greek SMEs triggered the adaptation of the system to a product-like version which could be offered, as a turn-key solution, to the associated sectoral bodies. This version could be customised and installed in the premises of sectoral bodies or other relevant organisations (e.g. chambers of Commerce, chambers of Industry) and assist their members-SMEs in their interaction and promotion of products/services.

4.1 Description of the system

The system can be visualised as a 3-layers sphere (see Figure 4). The inner sphere consists of commercially available software (also referred to as off-the-self) like RDBMSs, OSs and middleware. Such software is used as a basis for the development of the system's applications. The intermediate layer - shell consists of generic, cross-enterprise functionality and database structure (sub-schema). The contents of the second, intermediate layer were structured in accordance to the business process rules encountered in the majority of SMEs that participated in the survey for the determination of user requirements. As stated above, the second layer is quite generic and needs further customisation to address the particular needs of the individual SME sector to which the system targets. This is the final and outer layer that is built on top of the other two. Technically speaking, the intermediate layer incorporates a standard synthesis for the underlying database in addition to basic functions - sub-modules (e.g. libraries, stored procedures) implementing part of the functionality of the final system.

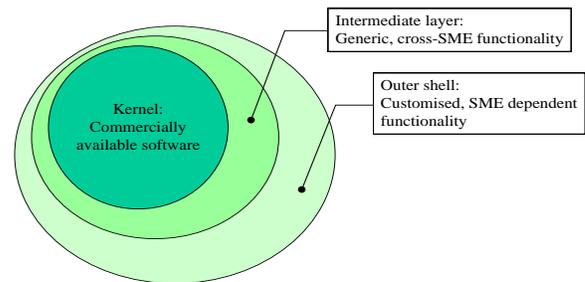


Figure 4. Three-layer structure of ERBC product.

4.2 Development of the system

The development and installation of the ERBC product goes beyond following the software development life-cycle. Indeed, the full potential of this product can be only exploited if it is used as a part of a strategic move of the sectoral body that adopts it. As with the adoption of any electronic commerce application there is a need for business process modelling and reengineering [9]. For this purpose a number of methodologies have been proposed, which can be also assisted by using a number of software tools (criteria for the selection of tools can be found in [10]).

The suggested methodology deals with the issue of companies adopting EC systems, by analysing the main commercial and technical issues resulting from such a move. The first result from the use of this methodology is the decision of whether or not to adopt an EC solution within the business strategy of the enterprise. Secondly, if there is a positive decision, the transition from the existing situation to the new business strategy is planned. In total, this methodology consists of 5 stages.

During the first stage the business environment is analysed, by examining the current situation regarding business-to-business transactions. The business strategies, the organisational structure and the day-to-day operation of the enterprise are documented, as well as the means for communication and collaboration with customers and suppliers, product promotion and payment mechanisms.

During the second stage, the areas of business activity in which EC solutions could be applied, are examined. By studying the results of the first stage, the areas that need improvement and the procedures that must be re-designed, can be identified. At the same time, existing EC technologies are examined that could be used to reach the desired level of improvement. The main applications are noted and various alternatives are proposed in terms of the way, resources, cost and time of the implementation. At the end of this stage, the need (or the lack thereof) for adopting EC solutions has been fully specified, along with the cost of the suggested implementations.

In the third stage, the resulting cost of the previous stage is calculated in detail in terms of materials, software, telecommunications equipment, and the need for additional human resources and training in the use of new technologies. The benefits from these solutions are evaluated by using qualitative and quantitative benefit indicators. Finally the best solution is determined, by examining the various alternatives in terms of the indicators mentioned.

During the fourth stage, the degree of integration of such applications in each specific area is determined. Then, a strategy is decided for developing and operating these applications, as well as for integrating them into the enterprise. As the integration plan refers to installing and operating an information system, it has to follow the

structure of a software development methodology and consist of several sub-stages, some of which may have been defined in the previous stages. What still needs to be determined, are the functional specifications of the system in question, and whether existing applications can cover the outlined needs, possibly with some alterations and additions (in relation to the ERBC product this corresponds to the development of the 3rd layer). The training of users and administrators follows (a methodology such as TNA is suggested) and suitable evaluation procedures are defined. Throughout the various stages, the project management intervenes in order to control the procedures and ensure that the right deliverables are being created.

In the fifth stage, on-line evaluation procedures are determined in order to identify possible discrepancies, discover their sources and take corrective measures.

Within the framework of the suggested methodology, major changes can occur within the enterprise. This however does not seem to be a significant drawback for a significant number of SMEs, as presented in section 2.

5. Conclusions and Future Work

The presence of Internet as the main wide-use and low-cost technological platform, makes it ideal for the development of EC tools and applications that will assist SMEs, in an efficient and cost-effective manner, to approach the new global electronic market. This is especially true in countries such as Greece, where SMEs constitute a significant part of the economy and have limited resources that could be allocated for such activities.

In this paper, based on our experiences from a number of projects related to SMEs in the EU and especially Greece, we proposed a framework for establishing efficient collaboration between SMEs, by addressing both technical and managerial aspects. The derived Internet application was presented with a special focus on the business process transformation (in terms of a suggested methodology) required, in order to achieve full integration within the existing organisational structures.

A number of the technological features of this framework were adopted by NCSR "Demokritos" during the development of a European electronic forum for the SMARTS / ACTS project (<http://www.smarts.org/>). SMARTS consists of a truly trans-european network of SMEs, linking together enterprises from various countries such as Germany, Austria, Finland, Greece, Russia, etc. with a number of strong national points offering support and information with the added advantages of native language text and fast connection speed.

One of the main achievements of SMARTS was the introduction of the concepts of electronic information and

commerce to Greek SMEs by providing them with up-to-date business information on a regular basis and a set of services, such as the presentation of company profiles and products, which were mainly based on the key concepts of the Business Directory and Products Catalogue modules (as illustrated in section 3).

Furthermore, the elements of the matching mechanism (as described in section 3) were utilised to assist enterprises in their quest to identify and establish suitable partnerships throughout Europe, for business or research in future European projects.

It is planned that a fully-featured EC application will be used by NCSR "Demokritos" for the PRAXIS/ACTS project (<http://praxis.tsa.de/>) starting in 1998, in order to provide the basis for linking together a number of telecommunication technologies that will provide SMEs with all the appropriate means for doing business electronically.

The extension of the provided services to include multi-media rich information, will be compensated by the use of a network of high-performance servers linked together by "hybrid Internet" techniques. This type of cutting edge technology makes use of satellite communication to enable the high-speed transmission of bulk data between the network nodes.

6. References

- [1] Carpenter C. D., Johnston C. W., Business-To-Business Electronic Commerce, BT Alex. Brown Research, October, 1997.
- [2] *Final Report (E21)*, SARBA Project (O2014), ORA Programme, National Rural Enterprise Centre, May, 1995.
- [3] Pressman, R., *SOFTWARE ENGINEERING - A Practitioner's Approach*, Fourth Edition, McGraw-Hill, 1997.
- [4] *Report on reseach by country (E10), Report for Greece*, SARBA Project (O2014), ORA Programme, Advanced Services Group, Ltd., December, 1994.
- [5] Berners-Lee T., Cailliau R., Luotonen A., Frystyk Nielsen H. and Secret A., "The World-Wide Web", *Communications of the ACM*, 37(8), 1994.
- [6] Postel J., "Transmission Control Protocol", RFC 793, September, 1981.
- [7] Coar K.A.L. and Robinson D., "The WWW Common Gateway Interface Version 1.2", *Internet Draft*, February, 1998.
- [8] *Deliverable on System Tools (D3)*, Advanced Services Group, Ltd., RegioNet Project, Telematic Applications Programme, 1996.
- [9] Davenport T. H., "Process Innovation: Reengineering Work Through Information Technology", Harvard Business School Press, October 1992.
- [10] Tsalgatidou A. "Selection Criteria for Tools Supporting Business Process Tranformation for Electronic Commerce", Proc. of the EURO-MED NET 98 Conference, 1998, pp. 244-253.