

Strategies in Implementing Efficient Information Systems

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Abstract: Implementing dedicated information systems within organizations is the most challenging part of IT strategies, since they significantly increase activity efficiency if properly implemented, and on the other hand, may cause major investment problems, otherwise. The paper focuses on the stages, principles and strategies of adequately implementing dedicated information systems. We sustain our statements by presenting a case study on “Babes-Bolyai” University

In Romania, the implementation of global management information systems which synthesize relevant information from all the organization’s compartments is still in its early stages. Nevertheless, the use of such systems has proven to be extremely efficient in providing an electronic management board and assistant for designing management strategies and synthesizing the organization’s activity

It is vital that organizations’ management be aware of the advantages that adequate information systems may bring into the organization and of the importance in adopting efficient strategies in choosing and implementing them

Keywords: organization efficiency, IT strategies, implementing information systems

1. Implementing Information Systems - Goals, Strategies and Stages

Implementing adequate ICT (Information and Communication Technology) strategies is essential for increasing activity and management efficiency within organizations, as proven in [AndP04]). The cited paper also shows that the implementation of dedicated information systems for managing organizations’ activity may be considered as the “top” level of an ICT strategy

In designing an information system for modelling the organization’s processes, the management levels, assisted by the IT manager and department will decide between in-house design and contracting the product with a specialized software firm [AndP04]. A proper solution will be chosen, like in any IT strategy, by taking into account the organization’s goal and its resources, both financial and human – IT specialists.

The adaptation of the information system to the organization’s characteristics and needs is indispensable to its success in increasing activity and management efficiency within the organization (while design flaws or the use of improper information systems can generate major disadvantages). This paper is dedicated to systematizing the aspects related to efficient implementations of information systems and the case studies sustain our theoretical approach

It is important that management levels be aware of dedicated software’s potential in significantly increasing organizational efficiency, if properly designed and implemented.

In implementing an information system, organization’s management should take into account its role in the design stages of an information system, especially in coordinating the process of offering complete and accurate specifications for the desired system. Lack of or inadequate user involvement in defining the system’s specifications will most likely lead to implementations that don’t satisfy their needs

The main goal of implementing an information system within an organization is to increase efficiency in organization activity by IT means – automatic information processing, adequate information and document management.

The system's implementation will also improve management efficiency since the on-line synthesis of most relevant information from organization's compartments / system's modules will turn into genuine electronic management assistants.

The implementation stages of a dedicated information system comprise:

- *Problem analysis and specification design* – within this stage, the IT team, in particular the project analysts, analyze the given problem and define it accurately. On the other hand, the users have to describe their complete requirements / specifications. In this respect, *the involvement of the organization in providing complete and rigorous specifications for its needs is essential* (since incomplete requirements will obviously lead to inadequate systems, and disadvantages in resource allocation, both for the IT team / firm and the organization).

It is vital that management levels be aware of the importance of this involvement in defining complete requirements and coordinate the process.

The goal of this stage may be concisely characterized by formulating “what to do” within the further development of the IT project

- *Design and implementation of the application* – this stage is performed by the IT team, based on the specifications created in the previous stage. Briefly, it is the stage of “how to do” and “do it”, performed by the IT team (with no direct user involvement)
 - Architecture design – aims at creating an efficient application framework; modern systems are designed on distributed, object and component oriented principles, in flexible n-tier frameworks
 - Choosing programming languages and environments – adequate to the system's implementation, architecture and to the software platform it is designed for
 - Application implementation – involves the whole process of application design, programming and development
 - Application testing – is rigorously performed on test batteries and potential errors are corrected
- *System installation* – is performed within the target organization and necessary comprises taking into account user feedback and, if necessary, make the corresponding adjustments. If the organization previously used a dedicated software system, then its database has to be exported into the new system. The stage has to be accompanied by proper user training
- *Maintenance* – comes after the system installation and involves all necessary future operations in order to ensure an efficient exploitation of the system within the organization and perform adjustments, if needed, along with the development of the organization's activity

It can be noticed that the user's role is essential in: evaluating the IT offer, creating the *system's specifications*, on site testing of the system, data collecting / export from previously used formats into the system's database. Among these stages, the most important impact on the system's efficiency is the user involvement in complete and correct specifications.

Users should also be aware of the most important principles in evaluating software systems:

- *The degree in which they respond to the specific system requirements* – software systems should be adapted to user needs

- *User-friendly graphical interface* – enabling simplicity in use and expressive visual interfaces
- *Speed in processing / response to user requests*
- *Security in distributed access* – the complexity of present organizations' processings require distributed access upon large databases, in respect with certain user rights, corresponding to user categories and goals. Moreover, specific accessibility domains over the system's database should be available to each user, according to the compartment he belongs to, to its position and activity (for example, operational levels or management levels)
- *Cost* – an efficient rate performance/ cost should be pursued
- *Flexibility, extendibility* - openness to future adjustments
- *Training, assistance and maintenance* – maintenance services consequent to the system installation should be paid attention when evaluating the initial offer because they are extremely important on long term. Actually, information processing within the organization will entirely rely on the implemented software system and it is highly recommended that such services be taken into account when contracting the system and included, with the corresponding details (including necessary specifications and price aspects) in the contracting documents

2. Management Information Systems and Their Advantages in Organization Management

Dedicated information systems model daily transactions and ensure access to analyses and solutions for various types of final users. The results are most often generated as reports but users may also interactively interrogate the system.

As show in the previous paragraph, users have an important role in collaborating with the team that designs and implements an information system by: rigorously defining the problem, specifying the information to be processed and the specific rules or algorithms to be pursued and the final goal of the system. Most often, subsequent modifications to an information system prove to be extremely costly both for the development team and for potential user resources (effort, time, money).

Modern information systems involve [And03]:

- *data processing* - collecting and processing organization's daily transactions (accounts, invoices, credits, rates, stocks, etc.). Such processes have been extended from local systems to distributed ones (shared in computer networks). Daily transaction processing provides information for tactical and strategic planning and is essential to the organization
- *database management* - database management systems are software products dedicated to processing large data collections organized as databases. The data base organization is consistent, flexible and efficient, ensuring processing procedures' independence from data representation techniques. Databases also offer integrity protection mechanisms and may evolve in gradual phases. Database management and extracting relevant information by specific queries (data mining) are important for all management levels: strategic, tactical, operational.

Most information systems that are implemented in the economic environment rely on database management, as they involve processing large amounts of data

- *interactivity* - since final users of information systems may belong to various user categories, the system must response in real time (directly and instantly) to any type of request. Once visual and accessible software has been developed, the

use of computers and information systems has extended to the general public with basic knowledge in computer use

- *decision assistance* - supporting management decisions mainly by providing specific analyses, predictions or finding the optimal solution under certain constraints, consequent to data / transaction processing (see [Luc95]) for further details and examples). The main applications of these facilities regard modelling, choice analysis and decision taking, the implementations being interactive and mainly dedicated to managers. Such automatic facilities may partially model the problem that is dealt with, the system functioning as the manager(s) assistant in taking the appropriate decision. Nevertheless, a decision assistance system must integrate a data / knowledge base, a software which processes it and specific decision assisting modules: modelling and simulation packages, analysis and prognosis facilities, linear and non-linear programming, regression modeling, risk analysis, expert systems, etc.
- *expert system facilities* - ensure an advanced mode of assisting decisions, since they include experts' knowledge on a certain field as a knowledge base, which tends to be exhaustive for modelling that field (ideally, an expert system replaces human experts in a certain field) - see [Lug97] for details
- *executive information services* - are dedicated to the superior management level and group facilities for extracting relevant synthetic information from the information system; the selected data most often cover organizational critical areas. Executive information systems / facilities must be user-friendly, must ensure fast access to information and efficient exploration of the database - "data mining", adequate data analysis (tendencies, prognosis, data integration etc.) and must generate clear outputs
- *distributed facilities* - nowadays, information systems function as multi-user systems, accessible from various geographical locations, over computer networks or within the Internet. Internet applications have developed in a rapid pace and have become very popular since they are efficient, very accessible and easy to use. E-banking, e-payment or e-commerce facilities / systems have spread on the Internet, based on rigorous security mechanisms [Tan97] implemented for private information exchanges

ICT implementation has an important impact on organizations within:

- *human resources policy and skills* by
 - modifying the requested personnel skills and the work style, the interactions among employees and the departmental interactions, as well as outer-organization interactions, with suppliers and clients. Information representation, processing and communication means are changed; these features induce modifications in the organization's structures: certain jobs may disappear and others (usually, less numerous) may appear, based on ICT facilities
 - reducing manual work and physical routine since various operations are transferred into IT; work productivity is therefore increased. On the other hand, computer use and data processing skills become necessary for almost all personnel. Therefore, knowledge in operating office automation software becomes indispensable for most jobs
 - inducing mutations in professional responsibilities by combining assignments from several traditional jobs and enlarging decisional levels by integrating tactical management and extending the operational level's responsibilities
- *operational impact* , mostly for the organizations which use distributed database systems (such as commercial networks, tourism or ticket reservation

agencies). Client interactions also change and move towards ICT facilities. Information systems which implement electronic means of performing activities, such as e-jobs, e-banking, e-commerce and so on, have a major social impact

- *organizational impact* by reducing the traditional number of levels, based on superior management's capabilities of administering more directly the organizational activities. Certain traditional departments of manual workers are transformed while an increasing number of activities is taken over by information systems

The major impact that ICT has a within organizations has to be taken into account by the organizational management

3. Information Systems in Romania

As the economic field controls the most important financial resources within our society, the IT implementation level within this environment is higher than the average in Romania. Moreover, within the business environment, IT is implemented more extensively within SMEs (Small and Medium Enterprises) since they are very flexible and, as shown in [AndP04], moderate investments within such organizations may bring relevant benefits.

We consider that, on a general scale, Romania is in the ICT stage of developing dedicated information systems. A study [And04] we performed by administrating and interpreting an evaluation questionnaire in the county of Cluj sustains this statement. The study is undergoing but since some of the intermediate results are quite relevant - see [And04] for statistical motivation, we further discuss them.

According to this study, *40% of the total employee number in the firms from our sample have access to their own computer.*

Computer networks and Internet connections are used on a large scale – 95% in our sample. Moreover, around 80% of the firms in our sample have their own website, mainly used for promotion purposes and communication ones [And04]. Evolved e-commerce facilities are not yet implemented on a large scale.

Regarding the *software* that is used, we noticed almost equal proportions among: *office automation, database, Internet, financial and specific software* (around 14-16%) – see figure 1. As predicted, management software, which imposes a consolidated integration of the most relevant information from all departments comes with a lower percentage – 9%. Human resources software was rated with 8.

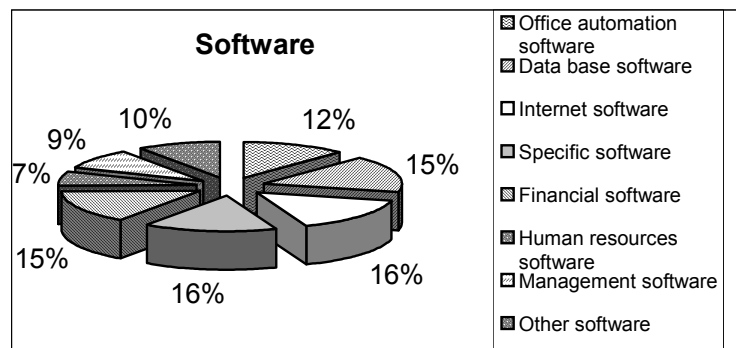


Figure 1 – Types of software that were used in our subject group

The most used Internet applications regarded, as expected within the business environment, *e-business* – 21%, *e-payment* – 21%, *e-commerce* – 12% and *e-news* – 12%.

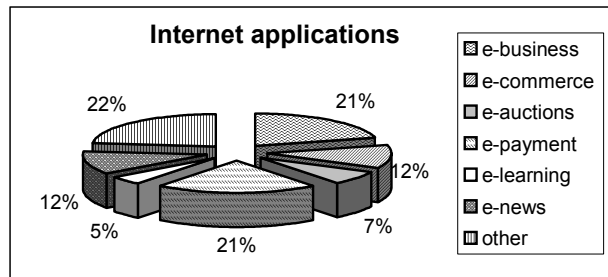


Figure 2 –Internet applications that were used in our subject group

The most important facilities offered by means of the web site were: *marketing and promotion* – 37% (ranks on the top as expected, since it represents the first step in moving the business towards the web), *external (client) communication* – 24%, *internal (employee) communication* and *product distribution* – 7-8%.

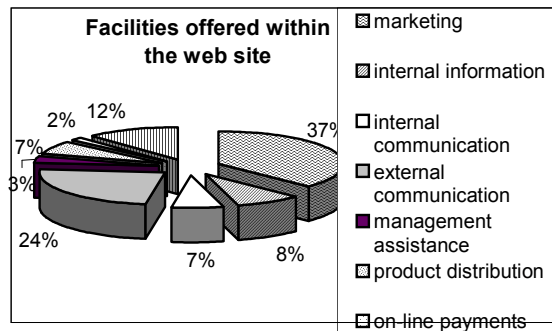


Figure 3 – Facilities offered within web sites in our subject group

The last year investments in ICT for small and medium enterprises are further discussed (see figure 4). 18% declared total ICT investments higher than 75%, 14% in the interval (50%, 75%], 9% in the interval (30%, 50%] and 31% - investments lower than 30%. 28% declared no investments in ICT for the last year or had blank fields.

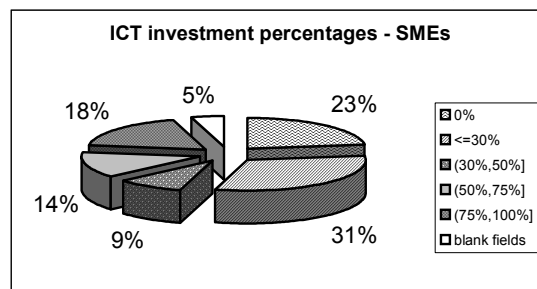


Figure 4 – Distribution of ICT investment percentages in our subject group

ICT created new jobs for 66% of our subjects, in various percentages, which is again a relevant result for the impact of ICT upon enterprise activity, work style and management. A majority of 70% in our sample sustain that IT strategies influence human resources policies and management strategies.

4. Case Study: Implementing Information Systems within Babes-Bolyai University – BBU

As we state in [AndP04], IT strategies are easier to implement in small and medium organizations, since they are more flexible; moderate IT investments in small to medium organizations, if adapted to their specific goal, bring significant advantages. IT strategies must be more elaborated in larger organizations, taking into account their complexity.

Comparing the public and private sectors, we can observe that resource availability is more dynamic in the private sector. Academic institutions, on the other hand, can compensate this trend with consistent “know-how” and by attracting alternate resources, as further discussed

BBU is a large organization, in the Romanian public sector, aiming at providing academic education programs for the society. With over 40,000 students and over 2000 academic staff and employees, BBU is one of the largest universities in its geographical area. Competitiveness and international compatibility are among the major goals of its management. Aiming at increasing the efficiency of its didactic and research activities, BBU’s strategy included means of obtaining self-attracted income, which presently, almost exceeds its budgetary financial support.

In the field of IT, BBU recently invested in upgrading its large communication network and is in train of upgrading its information systems. In this respect, BBU decided to adopt an in-house strategy. This solution is sustained by the availability of qualified IT developers, the huge advantages in managing, upgrading and extending “in-house” systems and, of course, cost advantages [AndP04]

Two large scale software projects are currently under development within BBU’s IT Department:

- **AcademicInfo** - is a web based software application (see <https://info.ubbcluj.ro>) which aims at offering academic information, for various categories of users: students, academic staff, academic management. The application provides a user-friendly web interface and appropriate security mechanisms [And-a104]. Currently, there are implemented the facilities dedicated to students and academic staff
AcademicInfo centralizes local databases from all faculties and is based on a structured layer design, therefore ensuring flexible future upgrades
- **ManageAsist** – is an ERP (Enterprise Resource Planning) software system, which targets the goals of modelling the activity and specific information processings within the administrative compartments of an university (Acquisitions, Finances-Accountability, Assets), and offering distributed access to the system’s facilities for various categories of users, including faculty managers and administrators, and providing relevant synthesis for management levels [AndS05]
Presently, the system contains the Acquisition module, which came first in our design mostly because there existed no prior system and the lack of electronic automation had severe disadvantages on the compartment's activity. Moreover, it corresponded to a moderate extent complexity processing, adequate to validate the design principles we intended to implement within the entire project
ManageAsist project is designed on multi-tier architecture principles in order to ensure easy extendibility of the project and natural development in stages [AndS05]

The development of the above described applications is based on accurately documented specifications, enhanced by user feed-back. The design principles we applied [AndS05] ensure flexibility in stage development and extendibility

The in-house development strategy we applied proved to have significant advantages in:

- cost-performance rate
- stage development, flexibility and extendibility of projects
- internal management of software projects and IT autonomy

We expect that these advantages to be more obvious on a longer term

5. Conclusions

In the framework of the modern information and knowledge-based society, ICT implementation is a necessary condition for increasing organization efficiency. ICT strategies must be adapted to: the objective of the organization & the activity target field, the financial resources, human resources policies, management style and strategy. It is important that management levels be aware on a larger scale of ICT facilities' potential in significantly increasing organizational efficiency, if properly implemented

According to an undergoing statistical study we work on, the *most used distributed applications within Romanian SMEs regard e-business, e-payment and e-commerce*, which is an encouraging result with the view to transferring business on the web. Nevertheless, these facilities are mostly *used*, rather than offered, since *enterprise sites are still mainly oriented towards promotion and marketing*. This result sustains again the idea that *information system implementation is in its early to medium stages in Romania*.

According to the same study, ICT created new jobs for most of our subjects, in various percentages, while a *majority of 70%* in our sample sustain that *IT strategies influence human resources policies and management strategies*. This result reveals the importance and efficiency of ICT implementations upon organization activity, working style and management

Implementing information systems – the “top” level of an IT strategy should be properly performed in order to generate the desired benefits. In this respect, it is very important to take into account the users' role in creating the *system's specifications*, on site testing of the system, data collecting. Moreover, the implementation of information systems should be adapted to the overall IT strategy of the organization and must provide flexibility and extendibility in the development and implementation of the software systems

The case study we present on Babes-Bolyai University reveals the advantages of properly applied in-house IT strategies, which ensure flexibility of software project design in development stages

6. References

- [And03] Alina Andreica, *Limbaje de programare și sisteme informatice*, EFES, Cluj-Napoca, 2003
- [And-al04] Alina Andreica, Daniel Stuparu, Ana Bara, Oana Timiș, Florentina Tufiș, Flavia Mureșan, Carmen Ciplea, George Hristodol, Monica Bojan – *AcademicInfo – Web Based Application for Consulting Academic Information Databases*, Scientific Bulletin of “Politehnica” University of Timișoara,

Transactions on Automatic Control and Computer Science, vol 49 (63), No 5, 2004, p. 83-86

- [AndP04] Alina Andreica, Iustin Pop., *ICT Strategies for Increasing Efficiency in Businesses and Organizations. Case study on some Romanian Small and Medium Enterprises*, in Global Information Technology, Innovation and Entrepreneurship, Panagiotis Petratos editor, ATINER, Athens, 2004, p. 3-10
- [And04] Alina Andreica, *Study on ICT Impact within the Romanian Business Environment*, Proceedings of the International Conference on “Globalism, Globality, Globalization” – 10 Years of European Studies in Cluj , Faculty of European Studies, “Babeş-Bolyai” University, 21-23 October 2004
- [AndS05] Alina Andreica, Daniel Stuparu, *Advantages of Multi-Tier Architecture in Designing Complex Software Applications for Network Environments*, Proceedings of 4th International RoEduNet Conference, Tg. Mures, 2005
- [Bui01] Buiga, A, *Metodologie de sondaj și analiza datelor în studiile de piață*, Presa Universitară Clujeană, 2001.
- [Kot00] Kotler, P., *Marketing Management*, Prentice Hall, Upper Saddle River, New Jersey, 2000
- [Kot01] Kotler, P., Armstrong, G., *Principles of Marketing*, 9th Edition, Prentice Hall, Upper Saddle River, New Jersey, 2001
- [Luc95] Terry Lucey, *Management Information Systems*, The Guernesey Press CO Ltd., 1995
- [Lug97] F. Luger, W. A. Stubblefield - *Artificial Intelligence: Structures and Strategies for Problem Solving*, Addison Wesley Longman Inc., 1997
- [Rot99] Traian Rotariu, *Metode statistice aplicate în științele sociale*, Polirom, Iași, 1999
- [Tan97] Tanenbaum, A. S., *Rețele de calculatoare*, Computer Press Agora, 1997