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Dynamic risk management system for the modeling, optimal adaptation and implementation of an ERP system

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Abstract

Purpose – This paper aims to deal with the development of a risk management application for the modelling, optimal adaptation and implementation of an ERP system.

Design/methodology/approach – This paper presented a risk management application for the modeling, optimal adaptation and implementation of an ERP system. The application was tested with the operations and capabilities of the ERP commercial package "SINGULAR Enterprise (SEn)" of the Greek Software House DELTA-SINGULAR S.A.

Findings – The functional result of this application was proved to support considerably the management of risk within the implementation of the ERP system.

Originality/value – To the best knowledge of the authors there is no other current generic research in this technological field concerning small or medium-sized enterprises. With the development of this application, the goals mentioned in the conclusions were achieved.

Keywords Risk management, Manufacturing resource planning, Computer applications, Project management

Paper type Research paper

1. Introduction

The complexity that characterizes information systems along with the capability of use of particularly powerful computing systems has led to the development of applicable and effective procedures for the support of modeling, optimal adaptation and implementation of an ERP system (Laudon and Laudon, 1999).

An ERP is constituted of many sub-systems, which collaborate with the aim of complete cooperation and interaction of the enterprise departments and at the smoothing of the company operations. Generally, the complete installation of ERP and the start of the usage of ERP adjust the modeling and the optimal adaptation to the needs of the enterprise. On the whole, the complete installation of the ERP is very important project management and IT work. An effective method for achieving the desired installation is Goal Directed Project Management. Goal Directed Project Management is a comprehensive philosophy, process and method for managing projects, and has proven applicable to all kinds of projects ranging from behavioral change to large technical endeavors. The big difference between GDPM and other PM methods is its simple and scalable approach. It fits for large programs as well as for small projects.

A vital procedure of project management (Cleland and Ireland, 2000) and goal directed project management (Anderson *et al.*, 1995) is risk management. Risk

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management contributes in avoiding problems during a project, which can lead to deviation from project goals, timetables and cost estimation. So, an application for managing risks is very crucial for the success of a project such as the implementation of an ERP system.

2. An overview of risk management

In order to manage risks we have to understand the meaning of risk within a project. Risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives (Project Management Institute, 2000). A risk is characterized by the following (Hall and Hulett, 2002):

- it is a future event that may or may not occur;
- the probability of occurring is between 0 per cent-100 per cent; and
- the consequence must be unexpected or unplanned for.

Risk management is any activity that identifies risk and takes action to remove, reduce or control deviations from the requirements.

A generally accepted approach to risk management comprises a series of steps (Ritchie and Marshall, 1993), as listed below:

(1) Define the context and risk management criteria.

(2) Identify the risks.

(3) Assess the significance of those risks.

(4) Identify, select and implement risk treatment options.

(5) Perform monitoring, review and corrective options.

Each step is a convenient milestone for reporting, reviewing and action taking. Each subsequent step depends on the work completed in the previous step. It provides an evolving understanding of the issues and development of progressively more robust risk management actions.

3. Overview of existing systems

In most cases of modeling, optimal adaptation and implementation of an ERP system, risk management is conducted. There is not a certain and structured methodology or application in order to avoid pitfalls and omissions during the risk management process.

For that reason, some ERP vendors such as SAP and Baan have tried to provide certain methodologies and applications as to conduct successful risk management.

Specifically, SAP has a risk assessment application. The application's purpose is to provide an objective measure of the degree to which the organization believes the R/3 implementation is credible and profitable to the organization, and to individuals. In addition, this application shows the change team how they could strengthen the credibility and perceived benefits of the R/3 implementation. This intelligence will be used to drive the change management initiative (*SAP White Paper*, 2003).

Baan provides a risk manager with which the project manager can conduct a risk assessment. In response, the system calculates the risks that may appear and provides mitigation strategies.

With the support of such systems, the project manager makes a more realistic cost and time estimation. This defines in a more accurate way the goals and the desired outcome and avoids possible future problems, which may end in unwanted results. But SAP and Baan, along with other ERP vendors, which have certain methodologies, have designed these applications for the needs of their own ERP systems. These risk management applications are not generic and thus cannot be used at the implementation of any ERP system. For this reason, and for some other desired functionalities such as network access and dynamic content, the development of a dynamic and generic risk management application is necessary.

4. Methodology and functionalities

The main purpose of this system is to be a useful and necessary application for a project manager and the people who are involved in the modelling, optimal adaptation and implementation of an ERP system.

The main users of the system should be the project manager and his/her team, the consultants and, of course, the administrator of the system.

The demand for continuous and direct communication between the project manager and the consultants, urge the application to be accessible via network, intranet or Internet. Due to the fact that every project has different risks, the proposed application should have a wide spectrum, should be dynamic and should offer safety. Its spectrum should have a large variety of risks and at the same time should be able to manage the risk management data. Additionally, the user should be able to manage the risk management data only if his/her role allows it.

The proposed application should have the following functionalities:

- *Risk assessment*. There should be forms with questions and possible answers in order to identify the possible risks. The questions should be generic and the user should have the capability not to choose an answer, if this is not suitable for the specific project.
- *Risk scoring*. There should be a calculation and presentation of the risk percentage per category and in total.
- *Graphical presentation of the scored risks*. There should be a graphical presentation of the percentage of the identified risks per category.
- *Risk impact and mitigation strategy*. According to the identified risks, the system should dynamically present their possible impact and strategies to mitigate them.
- *Print*. The system should provide to the user the capability of printing the reports and results.
- *Data management*. There should be an application, with which the users could manage the risk data.

5. Architecture of risk management tool

For the development of the proposed application, ASP pages (Ricard and Asbury, 2000) and Microsoft Access 2000 were used. With the use of these platforms, the application becomes dynamic and accessible via a network.

The system consists of three sub-systems: the risk management system, the data management system and the database system. As mentioned before, the application will support three groups of users: project manager, consultants and system administrator. The first two groups have access only to the risk management system, while the administrator has access to the data management and to the database system.

Database sub-system
The database has the following fields:

(1) *Questions:*
- question;
- category;
- description;
- mitigation;
- subcategory; and
- weight.

(2) *Answers:*
- answer;
- description;
- question; and
- value.

(3) *Category:*
- category; and
- name.

(4) *Results:*
- results;
- category;
- question;
- answer;
- risk;
- max_risk; and
- user_ID.

Each field, Category, Questions, Answers and Results has a type (autonumber, text, and number) and a description.

There is a structure in the relationship among the fields, which has the following sequence:

When a category is deleted, the equivalent registrations from the matrix Questions are deleted, also.

A deletion of a question in the matrix Questions, has as a result, the deletion of the equivalent registrations in the matrix Answers.

Additionally, a deletion of a registration in the matrix Answers, has as a result an equivalent deletion in the matrix Results. So, deletions in Questions and Categories have influence on the Results.

Risk management sub-system

The risk management system has the following functionalities:

Risk assessment. The data are divided into categories. Each category has sub-categories and each sub-category has one question and three possible answers. Each answer has concrete danger. Thus the first answer has no risk, the second one has medium risk and the third one is of high risk. Only one answer can be selected for each question. In the case that no answer is selected, the corresponding sub-category is not taken into consideration. The user doesn't choose an answer/sub-category if he/she finds it inappropriate for the project (Figure 1).

The existing categories and relevant sub-categories, until now, are the following:

(1) *Project definition:*
- project importance;
- benefits of new system;
- availability of documentation;
- requirements;
- project scope;
- dependence of other projects on this project; and
- schedule interruptions.

(2) *Project size:*
- calendar time;
- departments to coordinate;
- hours of effort;
- project team size;
- sites;
- multi language;
- end users; and
- implementation strategies.

(3) *User organization:*
- changes to organizational structure;
- organizational alignment;
- policy changes;

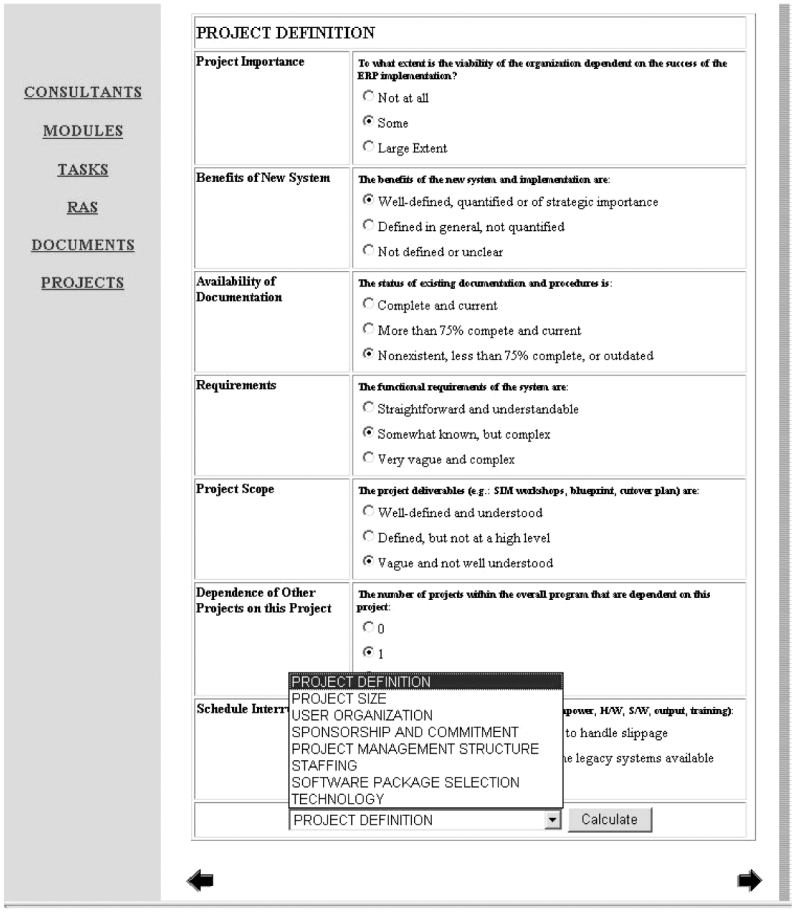


Figure 1.
Risk assessment

- procedural changes;
- performance measurements;
- behavioral change;
- change management; and
- business disruptions.

(4) *Sponsorship and commitment:*

- number of project sponsors;
- project sponsorship;
- project scope is within project sponsor's span-of-control;
- commitment of user management;
- commitment of user organizations;

- relation to strategic information systems plan; and
- project priority.

(5) *Project management structure:*
- scope management procedures;
- knowledge coordination procedures;
- methodology use;
- methodology experience;
- risk management procedures;
- quality management procedures;
- project reporting and tracking system; and
- infrastructure.

(6) *Staffing:*
- full-time project manager;
- project manager experience;
- full-time project team;
- project team continuity;
- experience as a team;
- subject matter expertise;
- user knowledge;
- decision making authority;
- team location;
- change agent skill;
- qualified trainers; and
- PCs and productivity tools.

(7) *Software package selection:*
- multi-vendor solution;
- knowledge of package;
- function requirements definition;
- functional match to requirements;
- is involvement in package selection; and
- software customizations.

(8) *Technology:*
- new or non-standard hardware or software;
- new tools and techniques;

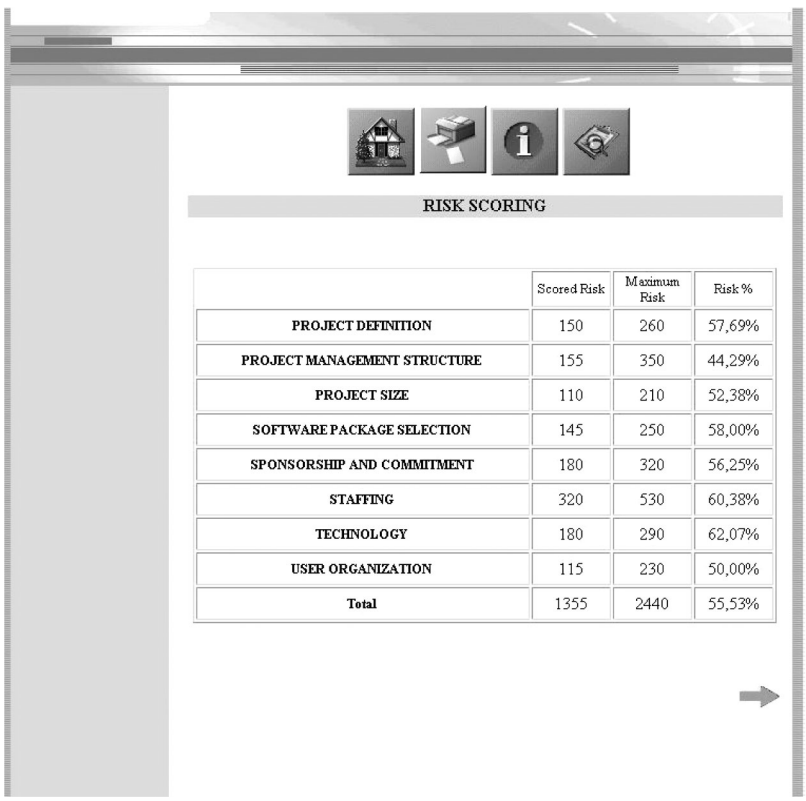
- interfaces to existing systems;
- data complexity;
- data quality;
- database management; and
- requirements for system availability.

As we have mentioned, these categories can be upgraded by the user.

Also, the user has the possibility to choose the categories that she/he finds important to the specific project. Only the categories that will be chosen by the user will be shown on the risk calculation.

Risk calculation. After having answers to various questions (on each category), the system calculates the resulting risk, the maximum risk and the percentage per category and in total. It presents the results as they are shown in Figure 2.

Each question has a value, which range is between 0-10. Its value depends on two elements: How important the project manager and the consultants consider this subcategory for the project and the possibility of the risk's appearance. Each answer has a specific risk. From the combination of these two elements, the value and the risk, results the scored risk.



RISK SCORING

	Scored Risk	Maximum Risk	Risk %
PROJECT DEFINITION	150	260	57,69%
PROJECT MANAGEMENT STRUCTURE	155	350	44,29%
PROJECT SIZE	110	210	52,38%
SOFTWARE PACKAGE SELECTION	145	250	58,00%
SPONSORSHIP AND COMMITMENT	180	320	56,25%
STAFFING	320	530	60,38%
TECHNOLOGY	180	290	62,07%
USER ORGANIZATION	115	230	50,00%
Total	1355	2440	55,53%

Figure 2.
Risk calculation

Graphical presentation of risk percentage. The next step is the graphical presentation of risk percentage per category. This is possible either by bar graph, or by line graph. For this purpose a java applet has been created. Below is given a bar graph for graphical presentation of risk percentage per category (Figure 3).

Risk impact and mitigation strategy. Finally, only for the sub-categories that present some risk, the system presents the possible risk impact and suggests a mitigation strategy. So the manager has only the necessary proposals for the tasks she/he needs.

The possible risk impact is based on the experience of the project team and the consultants.

The next stage, during the risk management procedure, is the mitigation of the risk. For this stage, a form has been created. This form analyzes every possible risk and presents ways of dealing with each risk. Also, it presents methods for the mitigation of the risks' sub-categories. If an answer with no risk is chosen, no risk strategy will be presented. With every use of the application, additional information can be added.

As mentioned, for each category which presents danger, there is a mitigation strategy. Below are presented the mitigation strategies for each category/sub-category:

(1) *Project definition:*

- *Availability of documentation:* Lack of documentation can hinder the progress of analyzing the requirements because the project team cannot quickly gain a good working knowledge of the current system. It may also cause analysts to make assumptions or build new requirements based on incorrect information.
- *Requirements:* Holding frequent and formal walkthroughs will help facilitate the spread of knowledge throughout the team. It also builds consensus of the requirements. The estimates for the implementation schedule should also be increased to support these activities. This documentation is included with the project documentation.
- *Project scope:* Poorly defined project scope can result in a lack of focus by the project team. This lack of focus can also result in wasted effort investigating

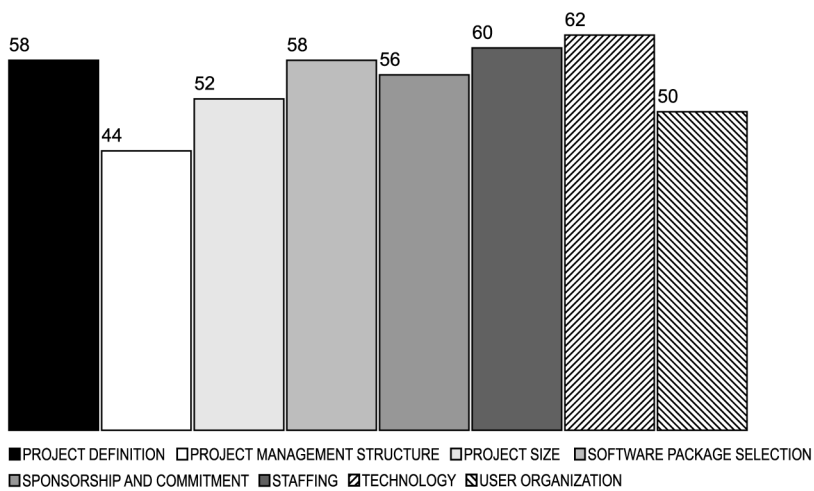


Figure 3.
Risk management graph

areas outside the project boundaries. Review the project scope with the user and establish procedures for changing the scope after the project begins. Distribute the project scope definition to all members of the core team. Continually monitor the defined scope against the actual project activities.

- *Dependence of other projects on this project:* The lateness of other projects (e.g.: another software implementation, a program to establish new standards, the acquisition of a business, or re-location of personnel) could cause the project to miss its deadlines. It could also create competition for key resources. A liaison should be designated to communicate with other project teams and to schedule regular meetings with them. Team members from both projects should participate in one another's walkthroughs. Contingency plans are critical in case the dependent project date slips. Extra time in the work plan may also be required to coordinate inter-project issues.
- *Schedule interruptions:* Schedule interruptions or slippage are always possible. To the extent that there is no contingency plan (e.g. legacy system can be available for a month longer), this can pose a significant risk. The project team should be aware when there is no room for schedule interruptions. The project management will need to monitor critical path activities to ensure that the project is meeting its milestones and deadlines.

(2) *Project management structure:*

- *Scope management procedures:* There is significant risk of losing control of the project without an effective plan for identifying, requesting, tracking, evaluating, approving, and implementing changes to scope. All changes, even minor ones, require additional work by the project team and therefore increases to the schedule and budget. A formal scope management procedure should be established for the project. These procedures should be used for all deviations against the Project Charter. The charter and the scope management procedures must be agreed on with the project team and the Steering Committee before the project begins.
- *Knowledge coordination procedures:* Knowledge coordination becomes more critical with an increased number of user organizations, implementing several sites, and different physical locations of the project team. Project communication and reporting structures become critical with complex knowledge coordination requirements. The team members should participate in regularly scheduled meetings, develop regular status reports, and utilize a common repository for knowledge objects (e.g. issue resolutions, change requests, status reports, etc.). Standards for submitting information should be developed along with a formal knowledge coordination procedure (e.g. Project Implementation Handbook).
- *Methodology use:* Without a standard approach, team members often rely on their own (and generally different) methods for implementation or no methodology at all. This can result in poor communication, inadequate estimating and planning, inconsistent documentation, and lack of a quality and review process. Target Enterprise should be used on all Baan-led projects.

- *Methodology experience:* There is no substitute for experience. Until the organization has some practical experience of applying the methodology, there will be risks associated with the learning curve, user acceptance, and integration of the local needs, practices, and culture. In the initial project stages, there should be an education process for the project team on the methodology. Examples of deliverables should be provided where appropriate and standards should be put in place for promoting consistency across teams and sites. The project manager especially needs to clearly understand the process and the deliverables at each milestone.
- *Risk management procedures:* This risk assessment should not be a one-time event. If risk management procedures are not instituted, chances are great that the project will be facing negative events unprepared, with an impact on duration and costs. Risk management is an integral part of project management and risks should be monitored and controlled frequently during the project. This starts by doing frequent risk analysis, following a clear procedure. The risks with high probability as well as a high negative impact on the project must be discussed most thoroughly. As an outcome the project manager should define actions to minimize the probability that the risk come through and/or should define a contingency plan to be able to react adequately once the risk becomes reality.
- *Quality management procedures:* If quality management procedures are not instituted, chances are great that the system will not meet the user's expectations and additional time will be required/spent to revise defective work. Quality checkpoints and procedures need to be established and agreed on with the project team and communicated to key stakeholders outside of the project team. Quality reviews should be performed periodically on deliverables (e.g. simulation test plans and scenarios, customization specifications, training material) and project management (e.g. work plan development, scope control, expectation management). Project management quality reviews should be formally documented on the work plan.
- *Project reporting and tracking system:* Project infrastructure is critical to facilitate the use of the methodology, to promote communication, and to monitor project quality. This infrastructure includes status reporting, issue identification and tracking, regular team meetings, regular steering committee meetings, time tracking, etc. This concept may or may not be new to the organization. The project infrastructure should be documented and rolled-out to the project team immediately at the initial stage of the project. These procedures need to be agreed on by project management and the Steering Committee. The project infrastructure should be documented and rolled-out to the project team immediately at the initial stage of the project.
- *Infrastructure:* Technical infrastructure (LAN/WAN, PCs) required to support the project infrastructure (common repository, issue management, meeting schedules, etc.) is critical for productivity during the implementation. If not already present, the technical infrastructure for

project team communication and knowledge sharing needs to be put in place before the project begins.

(3) *Project size:*

- *Calendar time:* The longer the project time frame the more difficult it is to maintain the project team's sense of urgency, which potentially leads to a slowdown in pace. High achievers might become impatient and leave the project and other personnel might be reassigned. The project may also become an end in itself for the team members causing them to lose sight of the original business objectives. Utilize a phased implementation strategy to show early results and provide key functionality before the system is completely in place.
- *Departments to coordinate:* If the project is larger than a single business organization the knowledge coordination and needs become more complex. In order to manage the project more effectively, it should be partitioned into smaller project teams or divided into sub-teams responsible for separate segments of work or deliverables. Avoid duplicating effort and attempt to leverage strengths across sub-teams. Cross-team communication is critical in this approach.
- *Hours of effort:* Projects involving a large number of hours may cause project team members to lose enthusiasm and become complacent about producing high quality work. Managing projects with a large number of hours can also be very time consuming. Medium range milestones and deadlines should be put in place and monitored carefully. Provide for extra quality review points to ensure that problems are detected early. Delegate and rely on team leaders to help manage the effort.
- *Project team size:* If a team is too big for one person to manage directly, bottlenecks can occur, causing a slowdown and slippage in the schedule. Also, a larger team runs into more communication problems. Increase the project contingency by adding more time in the schedule for coordination activities. Divide the team into sub-teams responsible for areas of work or deliverables. Develop project infrastructure such as weekly project team meetings and status reports. Also, hold frequent cross team walkthroughs to facilitate the communication of issues and decisions.
- *Sites:* When the new system is intended to run in multiple sites, it may be difficult to define all requirements accurately – particularly if different sites serve different customers or have different policies and procedures. A firm understanding of the methodology and a good project infrastructure (status reporting, issue tracking, common repository) are critical for coordinating an implementation across sites. Regularly scheduled, in person, meeting of all sites involved will also help improve communications. A visioning project may need to be implemented before the implementation projects.
- *Multi-language:* The consequences of a multi-lingual user community easily are underestimated. Important project documentation and user documentation could be translated by a professional. The leader of project

meetings should be made aware of eventual communication problems. The project manager also should assess and control more cultural differences.

- *End users:* The number of end users who actually use the system also influences the level of risk. The higher the number, the more critical it is for solid procedures, effective end user training, and system performance testing. The project workplan should have time scheduled to address these factors based on the number of end users.
- *Implementation strategies:* Big bang approaches (all functionality in one time) may result in synchronization issues, conflicting priorities, and an unmanageable scope of work. On the other hand, temporary interfacing problems may occur when following the phased approach. Interface requirements, organizational assimilation of change, and the number of resources are all factors in deciding the implementation strategy. Typically, small chunks of work and incremental implementations utilizing an initial visioning project approach pose less risk to the customers business.

(4) *Software package selection:*

- *Multi-vendor solution:* When dealing with multiple vendors, name one vendor as the prime contractor. The prime contractor coordinates the contracts, synchronizes package versions, and resolves package integration issues. Build additional time into the schedule as a contingency for unexpected integration issues.
- *Functional match to requirements:* Additional time should be built into the project schedule for activities that surround either changing the software or changing the business policies and procedures. Strong project management is a necessity to ensure the appropriate decisions are made (change the software or change the business). Ask a customization partner for high level estimates for customizing the software to get an idea of the initial cost involved.
- *IS involvement in package selection:* The support of the IS or technical team can be important to the overall implementation. The chances of them supporting the implementation increase with the extent that they are involved in the selection. If the IS or technical team was not highly involved in the selection, they should become involved immediately in the project planning phase. Project management should solicit their input and address any concerns they may have in the early stages of the implementation.
- *Software customizations:* The project philosophy towards customizations needs to be established early and adhered to throughout the implementation. Often, the implementation begins under the assumption that there will be no software customizations. Then as the implementation progresses, team members desire software enhancements that alter the initial project estimating assumption of a vanilla implementation. Standards for analysis and design of the customizations need to be put in place and followed. Sign-offs from the project team are also critical to ensure that both the functional and technical groups understand the required customization.

Major modifications should be identified in the project planning stages and time should be included in the project schedule for design, development, and testing.

(5) *Sponsorship and commitment:*

- *Number of project sponsors:* If the project sponsor is not strong, political battles between business units can result in project delays due to a lack of decision making or management commitment. This is particularly true of large projects. Clear project objectives and benefits should be established early in the project. These objectives and benefits need to be communicated to the entire organization, all project team members, and to key stakeholders outside the project team. The sponsorship needs to be regularly demonstrated to the organizations through daily activities and decision making.
- *Project sponsorship:* When more than one project sponsor is assigned to a project, decision-making and issue resolution may be less effective. In addition, there may be divergent views or conflict between project sponsors on the project objectives, benefit, and directions. Negotiate for the selection of a single project sponsor. If there are several key users that need to be involved, try to cast them into other project roles that keep them involved. If one sponsor cannot be selected, then clear guidelines for decision making and authority need to be established. An elevation procedure to the steering committee should also be put in place.
- *Project scope is within project sponsor's span-of-control:* The degree to which the scope of the project falls within the direct span of control of the project sponsor will determine the authority of the project sponsor to make key project decisions or to make resources available to the project. Once the project sponsor is identified, the project should not proceed until the appropriate authority has been identified. This authority should be communicated to the entire project team and demonstrably supported by the Steering Committee and executives.
- *Commitment of user management:* User management's lack of commitment to the project may indicate that they are unaware of the potential benefits of the project, dissatisfied with IS services, or planning a change in strategic direction. All benefits should be reviewed with the client management. Review strategic plans and emphasize the project's role in these plans.
- *Commitment of user organizations:* Even if user management is totally committed to the project, users can cause serious problems for the implementation teams by refusing to cooperate during the training and go live efforts. Users may do so because of fears about changes resulting from the new system. It is important to get other user organizations involved at various stages of the implementation (e.g. walkthroughs, end user training design). This will allow them to provide input to the process while giving them adequate time to accept any potential changes to their work structure.

- *Relation to strategic information systems plan:* The project is less likely to have its priority changed if it is part of the organization's strategic information systems plan (SISP). Not all companies, however, have a SISP. In any case, if the company priority of the implementation changes, it is likely that the implementation will be delayed and rework will result.
- *Project priority:* The project priority should be openly discussed with the steering committee before the project begins. Other company priorities, resources and timing for those priorities should be evaluated against the priority of the implementation.

(6) *Staffing:*

- *Full-time project manager:* If the project manager must manage several projects, or if they have duties or responsibilities on other projects, it may be difficult to focus attention on any of them. This may result in a lack of leadership for the project team(s). The organization may lose confidence in this person as a manager. It is also difficult to solve project-related problems or deal with crises when you are not at the project site. The project manager should communicate with their management and make it clear that they are over-extended. A formal issue tracking procedure should be established to ensure that issues raised in the project manager's absence are documented and tracked. An issue manager should be designated to monitor the issues log frequently.
- *Project manager experience:* An inexperienced project manager may have difficulties developing an efficient project plan and modifying that plan as the project progresses. This often results in project delays and missed deadlines. On a large, complex project such inexperience can be even more damaging. Potential results include increased budget, loss of user confidence, cancellation of the project, or cancellation of future work. If the project manager is inexperienced, they should attend formal project management training. If possible, they should review project plans and status reports from completed projects of similar size and complexity. Strong team leaders should be appointed to work with the project manager. Additional estimates should also be built into the project schedule as a contingency.
- *Full-time project team:* When team members split time between several projects, it is difficult to focus attention on any of them. Additional time is required to brief team members that have occurred in their absence. The work produced by part-time team members may be more error prone, thus causing project delays and a poor quality system. Project team members may also become complacent or unproductive due to the pressures of dual responsibilities or excessive travel. Resource allocation to the project team must be agreed on before the project begins. Action plans must be implemented to backfill the project team from their daily responsibilities and other projects. This decision must be communicated to the entire organization and supported by the other department heads and executives. Make sure the project schedule adequately reflects the

availability of project team members. If the project team members are required to work on another project, monitor their time closely. Do not let team members be available for another project on an as-needed basis. Limit their participation to one or two days per week for a finite amount of time.

- *Project team continuity:* Back-up personnel need to be identified for all key project team members. This is extremely important when the project schedule spans over a long period of time because retention becomes more difficult. These back-up team members help avoid rework of resolved issues and keep continuity with the project.
- *Experience as a team:* When a project team is composed of members who have not previously worked together, delays may plague the initial stages of the project. The team members need time to adjust to other member's personalities; to understand one another's specific skills, strengths, and weaknesses; and to learn how to work together. This risk can be compounded if the team is weak in certain technical skills or lacks industry or business knowledge needed to successfully complete the project. The project teams should be structured based on the experience, technical skills, business skills, and interest of the team members. Regular staff meetings should be held in order for the team to get to know one another and to keep open lines of communication. For extremely large projects, team building events or exercises may be considered at the project onset. Additional time may also need to be included in the project schedule.
- *Subject-matter expertise:* Without the adequate experience, the team will not have the insight necessary to avoid mistakes. Additional time may therefore be required for reviews and revisions. More frequent and more formal walkthroughs should be scheduled to facilitate the spread of knowledge throughout the team. These walkthroughs will also allow the project to leverage off of the people that do have the subject matter expertise. Additional time should be built into the project schedule.
- *User knowledge:* The project team's lack of knowledge about the business can lead to poorly defined or misunderstood requirements, user dissatisfaction and frustration, and increase in task completion time and in the time needed for revisions. Additional time should be built into the project workplan to consider the level of user knowledge on the project team. Mentors should be heavily utilized on the team, allowing novice and experienced members to work side by side on tasks requiring in-depth business knowledge.
- *Decision-making authority:* Project team participants must have the authority (and accountability) to make critical decisions about the application to facilitate efficient execution of the project. If the authority for decision making is not present, the project will become bogged down frequently at critical decision points and the probability of meeting the project dates is greatly diminished. Decision making authority should be delegated to each key resource for their area of expertise and responsibility. Clear guidelines should be established for the nature of decisions that will be made by the key resource and how those decisions will be made. The

delegation of the decision-making needs to be demonstrably supported by the project management and the Steering Committee.

- *Change agent skill:* Change management is an important, yet somewhat abstract aspect of the implementation. It is important to have strong leaders that can act as "change agents" for the implementation. This risk increases to the extent that there are business policy and procedure changes required. Consultants can often act as change agents in the beginning of the project. Their effectiveness as a change agent, however, diminishes as they remain with the project. Internal change agents are the most effective. These people should be identified and educated on the techniques of adapting people to change. Depending on the extent of business changes required, a formal change management methodology may be required.
- *Qualified trainers:* Qualified trainers will be required in the deployment stage of the implementation to train the actual end users. Some organizations already have in-house training departments that can perform this activity. Other organizations will elect to use the team leaders to perform the end user training. Additional time should be included in the project schedule if qualified trainers are not readily available. This additional time will be required to adequately design and develop training materials and courses. Alternatively, additional budget may be required to hire an outside training organization to develop materials and conduct courses.
- *PCs and productivity tools:* Depending on the technical sophistication of the organization, not all project team members may be familiar with PCs and productivity tools (e.g. Word, Excel, e-mail). This may hinder the productivity of the project in the early stages of the implementation. The project infrastructure should be designed with the project team's PC and productivity tool knowledge in mind. To the extent that the team is unfamiliar with the technology, base-line training classes should be conducted in conjunction with the rollout of the project infrastructure. Additional time should be included in the project schedule for these activities.

(7) *Technology:*

- *New or non-standard hardware or software:* Risk is involved if the technical team and the system operators are not properly trained in the use of the new hardware or systems software. This risk may be even greater if there are problems of integration between old and new hardware. If there is resistance to the change in the new hardware or systems software, the implementation will take longer. Provide training on the new hardware and systems software. Use experienced technical consultants on the project to transition knowledge to the project team.
- *New tools and techniques:* New tools and techniques (e.g. 4GLs, system software, networks, etc.) can lead to decreased productivity if the team uses them incorrectly or without proper training. Because mastery of such tools can involve considerable time, the benefits associated with them may not be seen during the initial stages of the project. Additional time should be built

into the project schedule for proper training and also for the learning curve involved with the new tools and techniques.

- *Interfaces to existing systems:* Improperly defined interfaces, or interfaces from one technology to another (e.g. hardware or DBMS) can result in increased complexity of testing, adverse effects in the systems being interfaced with, and a failure to meet the project schedule. Potential interfaces should be identified right away. The data definition and process that surround the interfaces should be a focus early in the implementation. Additional time will also need to be built into the project schedule.
- *Data complexity:* Failure to deal properly with complex data generally results in poor database design, inadequate system performance (response time and throughput), and difficult system maintenance.
- *Data quality:* Legacy system data is also difficult to convert when it is redundant, inaccurate inconsistent, incomplete, or not in machine language. The project team needs to ensure that the cost of converting complex or poor data is worth the expected benefits. All data to be converted should be examined. All data elements need to be properly defined. Keep simplicity in mind and avoid replicating the existing data problems. The data conversion process in many circumstances can take a great deal of time and could delay the implementation.
- *Database management:* The introduction of a database management system (DBMS) necessitates the structure and definition of the organization's data. If this need is not recognized, the project schedule may not be met and the database performance may be unsatisfactory. If the wrong DBMS is chosen, changing the system after implementation will be very difficult and costly. If the new DBMS is not clearly understood, the performance required from the new system may not be attained. This is a critical risk for systems that require rigorous on-line performance requirements. Additional risk may be encountered in the form of schedule delays if the new DBMS must interface with an existing, different database. The organization should establish a database administration (DBA) function if they do not already have one. Experienced technical consultants should be utilized in the implementation.
- *Requirements for system availability:* When building a system that requires almost constant availability, there is little room for error. The user's customers are generally inconvenienced if the system fails, so the potential for lost revenue is high. The project team should recruit staff with experience working with the selected database, hardware, and operating system. System availability options should be planned for early in the project.

(8) *User organization:*

- *Changes to organizational structure:* Failure to recognize and plan for organizational changes may result in people not knowing their new responsibilities or roles, or not being able to hire the right people in time for implementation. Another impact may be that users will not want to use the new system because they are dissatisfied with the new organizational changes.

- *Organizational alignment:* Prepare an initial organizational assessment regarding potential organizational changes and their effects. Have the customer project management review this document with the Steering Committee and with the customer project team. At major milestones, have the customer project team update the assessment. This approach will introduce people to potential changes early in the process and will allow the project team to provide input as they progress through the implementation.
- *Policy changes:* A new system inevitably results in changes in an organization's policies. Any delay in getting them made could delay the project. Also, when there are a large number of policy changes the risk is that some could be lost along the way. Ultimately, this results in confusion among the users and a system that is less effective than planned. The customer project management and team should make all decisions regarding changing organizational policy. The project team management should monitor the timelines of these decisions. A mechanism for documenting and approving policy decisions needs to be put in place. Even minor decisions should be documented and communicated to the entire project team.
- *Performance measurements:* Performance measurements on the implementation can be very effective (e.g. bonuses based on implementation dates). If the project team's incentives are based on prior job duties, they will not be as motivated to complete the implementation on schedule and on budget. Performance measurements for the project team should be discussed with the Steering Committee before the project begins. If agreed on, they should be communicated to the project team and tracked against milestones.
- *Behavioural change:* System implementation often times requires behavioural changes within the organizations (e.g. decentralizing control of the item master). Significant behavioural changes can pose high risk in that the users may reject the system. Also, if the culture of the organization is not conducive to change, this risk is compounded.
- *Change management:* Behavioural changes should be identified early in the project. They should also be re-examined at various milestones. If change is significant or if the organization does not adapt well to change, a change management initiative and consultants may be required.
- *Business disruptions:* Implementation schedules can often conflict with the peak seasons of a company's business. This can pose a risk on both the business and to the implementation. During the implementation planning phase, business schedules and peak times should be considered. Additional time will likely need to be added to the workplan if business disruptions are an issue.

Data management sub-system

An application has been created for the management of the risk data. Only the administrator has access to this application.

Initially, all the existing categories are presented. Each selected category is shown within a text area, where the user can select its name. Furthermore, for each selected

category, its sub-categories are presented. The user can create a new category, edit an existing one or delete it. With the deletion of a category, all the relevant elements: sub-categories, questions and answers, are deleted also. By selecting a sub-category, its elements are presented: the question, the answers, and the value of the question and the mitigation strategy of the possible risk.

Additionally, the user can create a new sub-category, change its name or delete it. The user also has the capability of editing the elements of a subcategory. The value should be between 0-10. For that reason, an alert message appears if somebody tries to put a value out of range (Figure 4).

For the creation of a new category or sub-category, the following form has to be filled in by the user (Figure 5).

In the case that the user wants to create a new sub-category, the first field (category) is omitted.

All the fields are obligatory to be filled in. The reason is that there is no meaning in the existence of a category or sub-category without elements.

6. Results

This paper presented a risk management (RM) application for the modeling, optimal adaptation and implementation of an ERP system. The application was tested with the

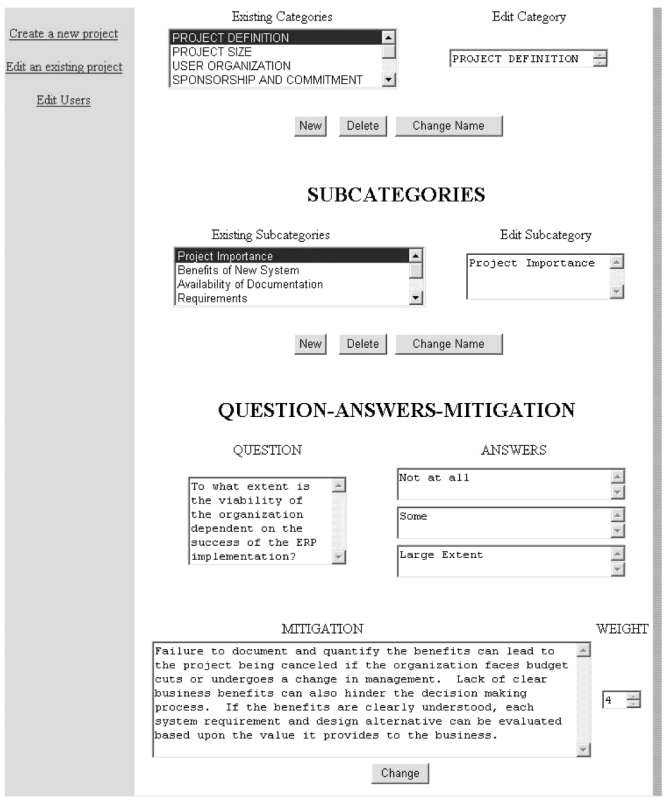


Figure 4.
Sub-categories' elements

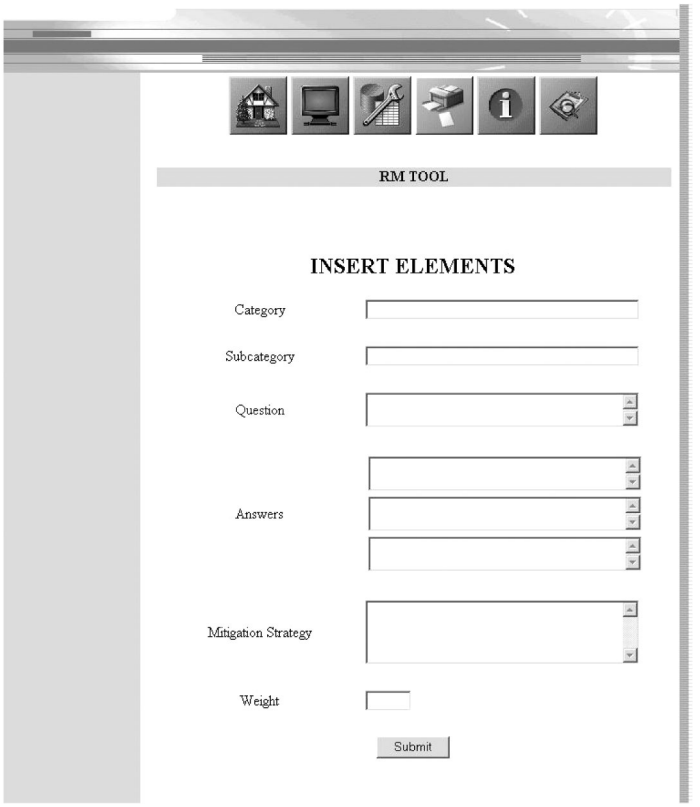


Figure 5.
Form

operations and capabilities of the ERP commercial package "SINGULAR Enterprise (SEn)" of the Greek Software House DELTA-SINGULAR S.A. The functional result of this application was proved to support considerably the management of risk within the implementation of the ERP system (Table I).

The RM application was applied without the need of any adaptations to the specific ERP package. As a result of its usage, the services provided by the company were upgraded and the project work was improved in the fields of time, objectives, communication and procedure. The project manager was able to keep up with the milestones, for the progress of each task separately and the progress of the project overall. The work of the consultants was absolutely controlled and the resources were best allocated. It resulted in the improvement of the image of the company that applied it.

With the use of the application by the company, an increase in the quality of the procedure of the implementation of an ERP system is expected.

With the development of this application, the authors achieved the following goals:

- a structured procedure to manage risk within the implementation of the system;
- knowledge repository on managing risk, through the dynamic structure of the application;

	Advantages of the risk management tool	
	Without using the RM tool	Using the RM tool
Procedure	No concrete and structured procedure	Structured procedure is provided, via choosing of categories for risk evaluation, then presenting the results and in the end providing risk impact and mitigation strategy
Knowledge repository	The consultants use only their own experience	The consultants can use the experience of others through the dynamic character of the application and the direct appearance of data that are imported
Communication	Lack of communication between project manager and distanced consultants	Direct communication through web
Objectives	Uncertainty as regards achievement of objectives	The objectives and the expected results are determined and they are re-defined taking into consideration the possible risks, so that problems which could result in failure will be avoided
Time	The duration of the project may exceed the time plan	Through the recognition and confrontation of likely dangers, a more realistic time planning of activities is conducted. As a result, this new frame constitutes the minimal time requirements
Resources	The problems appearing during the project may result in the need for additional resources, which may not be allocated	Through risk management, risks are recognized and are faced in time so that they won't create problems. But even if problems appear, it is something expected and thus becomes part of planning. In this way a most optimal planning of required resources is achieved

Table I.
Results

- immediate communication for the team's members through the web;
- certainty on the success of the implementation and the expected results;
- completion of the project on time;
- creation of a required resources planning; and
- control and reduction of cost of implementation.

7. Conclusions

As was mentioned, this paper presented a RM application that is an important part of the procedure of implementation and optimal adaptation of an ERP system to the needs of an enterprise. This application was connected to, and tested with, the operations and capabilities of the ERP commercial package "SINGULAR Enterprise (SEn)" of the Greek Software House DELTA-SINGULAR S.A. With the use of the RM application and a structured implementation methodology, an increase in percentage of success in implementation and optimal adaptation of ERP systems is expected.

To the best knowledge of the authors there is no other current generic research in this technological field concerning small or medium sized enterprises. With the development of this application, the following goals were achieved:

- creation of a risk management application, which is simple in use;
- an application, which has a dynamic content;
- an application, which is flexible;
- a risk management tool, which is generic;
- a risk management application, which is available over a network;
- a reliable application, which provides safety;
- an application able to cover almost all aspects of project risks;
- a risk management application friendly to users;
- an application with the ability to add value to the system for the modeling, optimal adaptation and implementation of an ERP system;
- a helpful tool to avoid pitfalls and dangers, through an implementation project;
- a helpful procedure to have a realistic cost estimation of the entire project; and
- an application which will contribute in optimizing time planning.

From all the above, it derives that its use should be mandatory in order to have successful management of a project and to gain the best from it.

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