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Project risk management methodology for small firms

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Abstract

We present a project management methodology designed for small businesses (SMEs), who need to run projects beyond their normal operations. These projects are critical to the survival of these organisations, such as the development of new products to adapt to the market or new legislation, management system implementations, etc. Very frequently, the managers of these projects are not project management professionals, so they need guidance to have autonomy, using minimal time and documentation resources. The risk management method outlined in this paper is based on extensive research with a large number (72) of Spanish companies. This new methodology considers the factors that are usually neglected by SMEs; i.e., project alignment with the company's strategy and results management. The methodology, based on project risk management, includes simple tools, templates and risk checklists with recommended actions and indicators. For validation it was tested in five different types of real projects (innovation, management systems and ICT implementation) of industrial and service companies with different characteristics.

Keywords: Small firms; Project risk management methodology; Strategic risks

1. Introduction

Small and medium enterprises (SMEs)[1] represent a very important part of the European economy, as they are the major source of jobs, create entrepreneurial spirit and innovation and, therefore, are essential to promote competitiveness and employment (European Commission, 2008). SMEs generate 66.7% of employment in the European Union, employing over 90 million people (Eurostat, 2011).

SMEs are companies with limited resources due to their size; therefore they must overcome great difficulties to cope with new projects. Besides, the need to open foreign markets, market evolution, legislation changes, management modernisation, etc. make it necessary for many small organisations to undertake projects. Projects are the main tool for change in these companies, and are often undertaken beyond their usual activities. They also tend to be internal and managed by unskilled staff. Small businesses do not generally use the most recognised standards in project management (i.e., PMBoK, PRINCE2R, ICB); in some cases due to ignorance, and in others due to their relative complexity it compared to the normally reduced size of SME's projects.

The aim of this paper is to present a project risk management methodology designed specifically for these situations, and

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[1] The new SME definition established by the European Economic Community in 2008 sets the following criteria for a company to be defined as SME:

SME thresholds	Staff	Turnover	Balance sheet
Micro enterprise	<10	<2 MEuros	<2 MEuros
Small enterprise	<50	<10 MEuros	<10 MEuros
Medium-sized enterprise	<250	<50 MEuros	<43 MEuros

It is interesting to note that even though it is obligatory to respect the thresholds referred to computing staff, an SME may choose to meet either the turnover limit criterion or the balance sheet; it does not have to meet both and can exceed one of the two and still be considered an SME.

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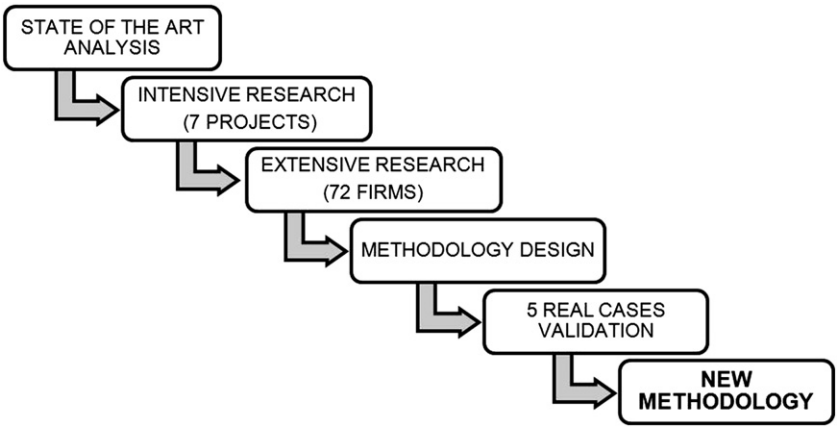

Fig. 1. Investigation phases.

successfully tested on five real projects. The methodology followed in this research is presented schematically in Fig. 1. After a literature review, with the collaboration of seven SMEs, a diagnosis of their needs was completed and the required tool characteristics were defined (Marcelino-Sádaba and Pérez-Ezcurdia, 2010). Based on these findings and with the collaboration of another 72 companies, we designed a methodology for such projects' risk management. This methodology was refined and validated experimentally with five new real projects' management. The criteria to choose both companies and projects, were to cover the widest possible range of companies (three micro, one small and one medium companies), and project types (an R + D project, an ISO standard implementation, an ERP implementation, an innovation project documentation and a document management system).

2. Literature review

In most cases, companies' growth in general, and SMEs in particular, is accomplished through projects. These projects should enable, through innovation, meeting the objectives, for which it is necessary to face new challenges and look for tools that facilitate this process (Retrato de las Pyme, 2011). However, SMEs have great difficulties in implementing projects, especially when it comes to raising capital, or seeking access to new technologies (Galindo Lucas, 2004).

The size of the company can be considered a key factor in business development, conditioning its behaviour (Fariñas, 1994; Rogers, 2004; Servicio de estudios del Consejo Superior de Cámaras de Comercio, n.d), since it is often necessary for companies to be larger in order to carry out certain investment policies, internationalisation, innovation or human capital. Therefore, smaller companies are the ones less likely to survive, especially in their early years.

The relation between firm size and innovation constitutes a highly relevant research topic and a controversial one, with an open-long-lived debate (Lee et al., 2010; Revilla and Fernandez, 2012). There is a large number of empirical studies which have reported positive, negative or even insignificant relationships between firm size and its decision to innovate (Kemp et al., 2003; Klomp and Van Leeuwen, 2001; Loof and Heshmati, 2002, 2006). The main reasons for such ambiguous findings might be attributed to industry-specific characteristics (Hashi and Stojcic, 2013).

It is not evident that larger firms are always better than SMEs in innovation. SMEs may have a strong capacity for innovation but often they lack the resources and knowledge to manage the whole innovation process by themselves. Although SMEs tend to have a higher R&D productivity than larger firms there is still much debate about the innovativeness of SMEs (Lee et al., 2010; Tomlinson and Fai, 2013). Currently, several publications have considered the importance of SMEs' access to corporate networks that help them overcome their limited resources and technology, thus, allowing greater technological opportunities (Chesbrough, 2003, 2007; Tomlinson and Fai, 2013).

In 2011, in Spain, 73% of the SMEs and 84% of the large firms carried out I + D activities executing 50.2% of the managerial expense in innovation (COTEC, 2012). Nevertheless, comparing the Spanish innovative SME percentage with other OCDE countries, it is possible to observe that Spain ranks first opposite to countries considered as models such as USA (16.8%), Germany (11.01%) or Japan[2] (6.29%). As EUROSTAT innovation statistics (2012b) indicates, the proportion of European innovative enterprises by size class (2008–2010) is very different according to the studied country reflecting the different structures of each domestic economy. Note that large enterprises tend to innovate more than SMEs and that large enterprises (with 250 or more employees) were more likely to have brought product innovations to market than either medium-sized enterprises (50 to 249 employees) or small enterprises (10 to 49 employees) (EUROSTAT, 2012a).

There is abundant information on project management and risk management, but there are few references on project management in small and medium organisations and small project management. According to Pérez-Ezcurdia and Marcelino-Sádaba (2012), there are major differences between small and large companies; which makes project management methodologies not applicable in all

[2] Japan does not include firms of less 50 employees.

cases. SME projects, in general, tend to meet one or more of the following characteristics (Turner et al., 2009).

- They are small.
- They are internal.
- Objectives are concretely defined.
- Team size is very small.
- They are concurrent with the company's daily activities.

In project management, risk management is a systematic process that aims to identify and manage risk, in order to act on its appearance (eliminating, minimising or controlling it), by implementing systems and procedures to identify, analyse, evaluate and address the risks inherent to any project (Conroy and Soltan, 1998; Raz and Michael, 2001).

Risk management must contribute to define the different project objectives, improve project control, increase the chances of project success, improve communication between project participants and facilitate decision-making and prioritise actions (AFNOR, 2003; Courtot, 1998a, 1998b). Therefore, risk management can help project managers to anticipate delays that cause projects not to be delivered on time (Grant et al., 2006).

Within the risk management process, risk identification is considered by many authors as the most important element of the entire process; since once the risk is identified, it is possible to take measures for its management (Chapman and Ward, 2007; Cooper and Chapman, 1987; Courtot, 2001; Hertz and Thomas, 1983; Perry and Hayes, 1986; Scarff et al., 1993; Wideman, 1992).

Project systems are in essence risky with many different types of risks, which make it impossible to identify them exhaustively. It is then essential to group risks into smaller and thus more manageable groups (Marle, 2002).

The failure of a project undertaken by an SME can have a very significant impact on its results. In many cases, the cause for this is the lack of alignment of the project itself with the company's medium and long term strategies (Yen and Sheu, 2004). To minimise the possible negative consequences, SMEs need to have appropriate methodologies and tools (Marcelino-Sádaba and Pérez-Ezcurdia, 2010; Unionpyme, 2007).

It must be noted that a project may have very different characteristics to the company daily activity, a fact that often requires different knowledge and management techniques than those needed for business management (Turner et al., 2009).

According to Ariful et al. (2006), there has been extensive research on risks and risk management. Most of it has focused on particular sectors, where the consequences of a system failure are considered catastrophic for people or the environment. However, there are far less studies on risk management in SMEs, as the risks are normally less catastrophic. Most of these analyses are limited to the identification, assessment and prioritisation of risks, their objective being the prevention of accidents (Marhavilas et al., 2011; Tixier et al., 2002).

The contributions found in the literature review on project risk management undertaken by SMEs are scarce, with limited application, and generally developed for project-oriented organisations (Aloini et al., 2007). Some examples are the work of Delisle and St-Pierre (2003), Blanc Alquier and Lagasse Tignol (2006) and Changhui (2007).

Various standards have been developed to help project managers (APM, 2004; AFNOR, 2003; IPMA, 2006; IRM, 2002; ISO, 2012; OGC, 2007; PMBOK, 2008; TSO, 2009), which set out rules and guidelines to achieve, through repeated use, maximum success of the objectives (Sanchez et al., 2009). Most of the cited project management standards were primarily designed to manage large projects and cannot be fully applied to project management in SMEs. Therefore their use requires at least one adaptation to the reality of the not project-oriented SME, as many of the risk management practices are far from being flexible (Blanc Alquier and Lagasse Tignol, 2006; Rowe, 2007; Smith and Pichler, 2005), and address the issue of risk from different angles (Allançon et al., 1991; Courtot, 1998a, 1998b).

The main key institutions in project management and their corpus of knowledge provide methods and techniques for risk management. Nevertheless, those methods classify risks based on one of their characteristics, but do not include their possible interactions; when these will always exist between risks that do not belong to the same cluster (Marle, 2011; Vidal et al., 2009). This vision is very close to the reality but adds complexity for SMEs, creating additional barrier to the project risk management.

SMEs need project management models that are less bureaucratic, with perhaps a different toolset to traditional versions designed for medium or large projects. They need different versions depending on the size of the project (medium, small or micro) to facilitate the risk management throughout the project life cycle (Turner et al., 2010).

We did not find in the literature review a risk management model for SMEs' internal projects, although there are some best practice recommendations for specific types of projects such as ERP implementations (Malhotra and Temponi, 2010). Therefore we tried to establish a reference in risk management to help solve the problems in relation to project risk management in SMEs.

3. New risk management methodology design

3.1. Identification of the methodology's needs and characteristics

The first phase of the investigation was to identify the difficulties that SMEs encounter when facing new projects. To this end the last projects implemented in seven different companies were analysed, detecting deviations and their possible causes (Marcelino-Sádaba and Pérez-Ezcurdia, 2010). We obtained some basic requirements that the new methodology must meet through its processes and tools.

To confirm the information obtained in this first analysis, a broader study was carried out in collaboration with an innovation consulting firm throughout the year 2010 in 72 Spanish SMEs, with whom we had meetings and general interviews about project management. We learnt from their experience in recent projects, the problems SMEs face in the development of new projects, as well as the needs and tools proposed by the companies for use in management. In this study all sizes of SMEs were included: 17

Micro (24%), 24 Small (33%) and 31 Medium enterprises (43%), covering 13 different industrial sectors. Among them, the main sectors have been: equipment (31%), services (15%), construction (13%) and automotive (10%). The findings of the study confirmed those obtained previously and provided the base for defining the main characteristics that the methodology should have (Table 1).

One of the conclusions of the study was that the small firms analysed often overlook the initial and the final project phases. So in these two phases, the project risks were more likely to materialise. On the one hand, the projects to implement are often not properly chosen from a strategic point of view. For this reason, we proposed an initial strategic filter to select the best project for the company. On the other hand, in practice, small companies hardly pay attention to the closing phase of the project, including the lessons learned and the project results management (documentation and protection). Even though the methodology proposed stress out in these two phases specially, it has been designed so that it could be used in all the project phases. Managing risks in every phase is very important in order to improve project success rates (Bush et al., 2005; Keizer et al., 2002; Pisano, 2006; Smith and Merritt, 2002).

3.2. New methodology's phases and tools

Taking as a reference the success factors identified by the PMBoK (PMI, 2008) on risk management, and following the criteria of Turner et al. (2009), in the sense that SMEs need to be guided on the set of project management tools that should be used, and not give them a larger list to choose; we designed a methodology based on the model proposed by the standard FD AFNOR X50-117 (2009), as it provides a simple distinction of risk management. In this methodology, tools were integrated according to a working method where, starting from a cause of failure, the effects on the project are identified.

This section explains the proposed risk management methodology, designed for basic risk management in internal projects, such as those typically managed by non-project oriented SMEs. Due to the importance that project success has on SME's results, an initial project selection/definition phase has been included, where strategic aspects need to be reviewed before deciding to implement it.

The proposed risk assessment, which should be more qualitative than quantitative in SMEs, will objectively prioritise risks according to their potential impact, in order to develop strategies and action plans as necessary. To manage the information we propose a fast and clear documentation method that would allow the information record to assist decision making throughout the project.

A relevant aspect is the integration of the periodic reviews of risks and their status into the dynamics of the company. In cases like those studied, where there are hardly any project management teams, in practice there are no weekly project meetings, which are common and necessary in larger projects where project risks are reviewed. The company, at the beginning of the project, will establish a review and control mechanism, which may be regular meetings between the project manager and the company management, or monthly quality control committee meetings, among other possibilities.

The next steps of this method include various techniques and tools such as risk checklists and strategies to manage the most common risks (see Annex I and II). The risks listed in these documents represent a summary of the specific risks of the SMEs found in the literature (Addison and Vallabh, 2002; Ariful et al., 2006; Barki et al., 1993; Boehm, 1991; Elonen and Artto, 2003; Entrialgo et al., 2001; Johnson et al., 2001; Leopoulos et al., 2006; Schmidt et al., 2001) along with the results of the initial study carried out and the experience of the authors in the management of this kind of projects. In addition, the indicators chosen for project monitoring and controlling must have enough information to raise 'red flags' and identify risks that have a real impact. As Bannerman (2008) pointed out, the value of these lists relies in the fact that the factors identified may also be important in other project types. After the process of validation of the methodology, we included risks that appeared in these experiences and others that the project managers had detected in the past.

As Chapman and Ward (2007) say, it is convenient to consider a generic structure of a project, often described in four phases (conceptualisation, planning, execution and termination). Also, in the Harvard Business School, four distinct phases are considered in the life cycle of a typical project (HBS, 2006). Nevertheless, the number of phases considered depends on the nature of the project and can include from 4 up to 8 or more phases (Kerzner, 2003).

Table 1
New methodology characteristics.

Methodology characteristics	It provides the project manager with a detailed project overview to detect changes and risks.
	It is straightforward and simple to use, to eliminate experience and training limitations.
	It minimises the process's limitations by properly defining the desired results.
	It provides simple and fast risk management documentation, as internal resources are scarce and often overworked.
	It provides simple tools, easy to understand and use, appropriate to the characteristics of SMEs and their projects
	It is flexible and adaptable in all types of projects.
	It allows the breakdown of the project into parts, to analyse in each of them the possible failures and consequences that these can cause.
	It allows the extraction of the implicit knowledge existing in companies by encouraging the participation and access to information.
	It provides sufficient information to facilitate and enhance operational and strategic decision making.
	It facilitates communication of individual events that may affect the development of the project.
	Using lessons learned is one of the key points for proper risk management and directly influences the achievement of success.

PMI divides the project in three phases, i.e., beginning or initiation, intermediate phase(s) and ending (Heldeman, 2002) and considers in their PMBoK (2008) five process groups, i.e., initiation, planning, executing, controlling and closing. Charvat (2003) stated that each methodology should contain project phases, and although those vary by project or industry, some general phases include: concept, development, implementation and support. Accordingly, the methodology proposed is divided into four phases: definition, planning, execution and control, and closure and results management. Based on the lifecycle of PMI (2008), Fig. 2 presents the relationship between the project phases and the new methodology defined. The used templates as well as the activities to perform and the documentation generated on each are included in Fig. 3.

3.2.1. Project definition: environmental analysis and project objectives

The first phase considered is the management of the potential projects that can be carried out, which requires an exhaustive work to select the most relevant ones. Many factors should take into account factors when selecting the right project (Heldeman, 2002; Kerzner, 2003; McGhee and McAliney, 2007), but most of them can be summarised in the following:

- Aligning project goals with the overall business strategy.
- Profitability of the expected result.
- Technical and management capacity to undertake the project.

The company's strategy is embodied in a strategic plan. This establishes a strategic line of work where projects should be defined. There is a need to link individual project risk management with the corporate strategic management to ensure that corporate objectives can be eventually achieved (Wang et al., 2010). This is the most important stage of risk management as success depends on it. Risk management at this stage is to ensure compliance with the following:

- Analysis of the context where the project will be developed.
- The project's defined objectives are in line with the company's strategy.
- There is a correct choice of participants, activities and resources with respect to the objectives defined and the type of project.

3.2.1.1. Project environment analysis. Some of the points to be checked and defined in the analysis of the business environment in relation to the project are: legal framework; internal factors of the participating companies (especially when the project is done in collaboration with other entities), and level of risk the company is willing to undertake in principle.

For a correct identification of the many factors that influence the environment, it is advisable to analyse the project on the following phases:

- Company analysis with regard to the project.
- Strategic definition of objectives.

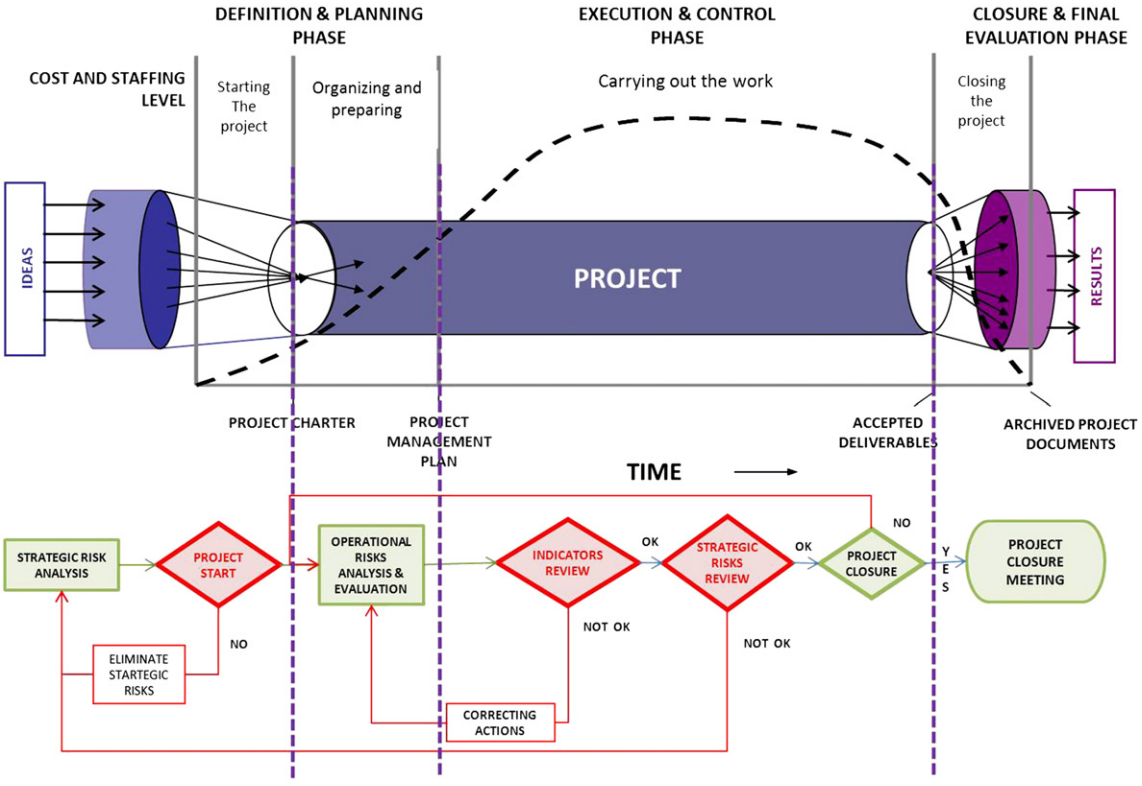

Fig. 2. Project risk management methodology proposed by phases (based on PMI's project lifecycle).

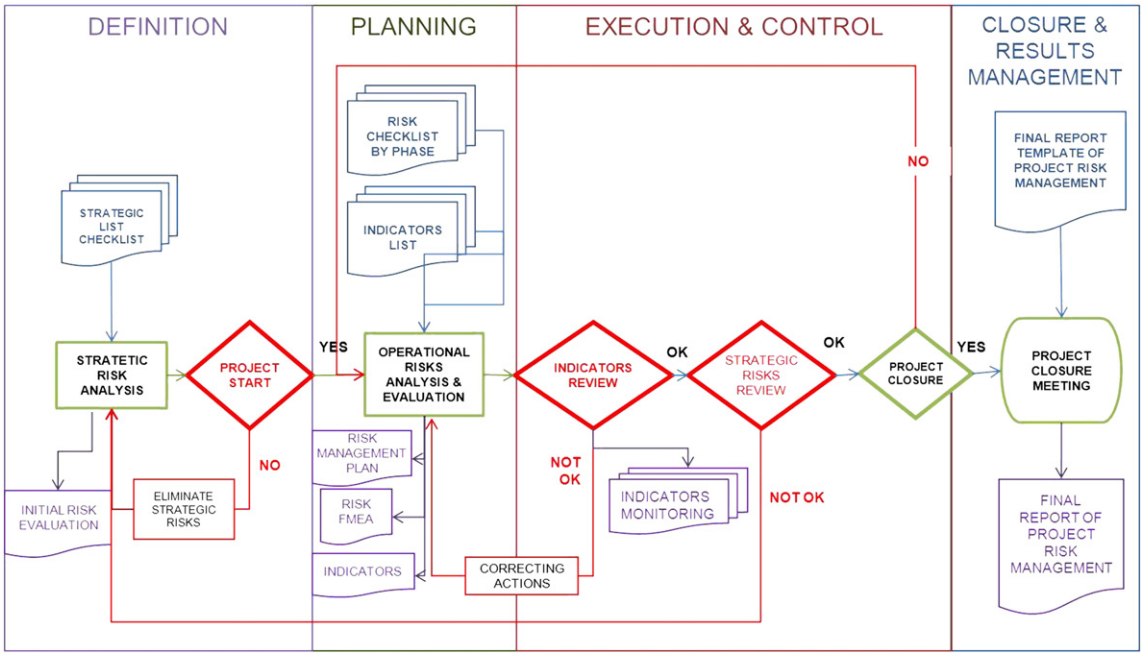

Fig. 3. Project risk management methodology proposed including activities and documents.

To properly define a project it is very useful to perform a company SWOT, seeking to reduce the weaknesses and threats and trying to enhance the strengths and opportunities.[3]

3.2.1.2. Definition of project objectives. A good definition of objectives is the key to a successful project. To this end, a preliminary analysis should be required to answer the following questions: WHY is the project going to be implemented, WHAT do we want to achieve technically, WHEN will it be carried out, WITH what resources, HOW MUCH will be spent, and HOW will it be executed.

The project strategic objectives are divided into several key areas:

- Project general objective, which is the reason for the project to be carried out.
- Specific objectives, defined in relation to the company's strategic objectives, which indicate the contribution to an improvement of: the market, the internal processes, the company's staff and their involvement in the activity, the company's products and the company's future.
- Objectives management, they are achieved by eliminating the barriers identified in the company's overall SWOT.
- Deliverables management: It is important to define the deliverables for each phase, because at later stages it helps find errors. They should be defined clearly and unambiguously.

3.2.1.3. Identification of strategic risks associated with the project. Identifying risks in the project definition phase is a critical task, since the risks that can be detected are strategic and must be removed before taking the decision to start with the project. We have considered strategic risks those whose materialisation can lead directly to project failure and even jeopardise the very survival of the company.

To anticipate and plan for risks, it is necessary to identify those items that should be properly defined and whose absence has a major impact on the project results. This information must be collected to facilitate a further review of strategic risks during the project implementation.

Annex I includes a checklist to assist in carrying out the identification phase of the project strategic risks. It includes the strategic aspects to be defined prior to deciding to undertake a project, their status (OK/NOT OK) and a proposed activity to assist in their removal and thus give a 'green light' to the project.

Once it is decided to implement the project, the next phase of the project is planning.

3.2.2. Project Planning

This phase includes three activities:

3.2.2.1. Definition of a risk management plan. A very important aspect of the risk management process is defining the frequency and the key times to monitor indicators controlling the identified risks and the people responsible for doing so. The definition of these aspects should involve all team members.

[3] STRENGTH: company's characteristic that provides an advantage and will serve to seize the opportunities that the project will offer. WEAKNESS: business' aspect that limits or reduces the effective development capacity of the strategy. OPPORTUNITY: quality, capacity, resource or possibility, provided by the environment that, properly harnessed, will improve competitive advantage. THREAT: quality, capacity, resource or possibility of the environment, which can prevent implementation of the project, increase risks and reduce effectiveness or resources required to tackle it successfully.

The proposed methodology includes, for example, a simple risk plan which includes tasks, responsible, monitoring frequency and generated documentation.

3.2.2.2. Operational risk identification. The objective is to detect most of the problems that may arise during the project and that are associated to project tasks (operational risks). Even though these risks put in danger in achieving some specific objectives, they do not put in risk for the viability of either the whole project or the company.

To anticipate and plan for risks, it is necessary to identify the tasks where they can materialise and where their appearance has a greater impact on project outcomes. Good risk identification includes, among others, the following aspects: origin, appearance phase, consequences, evaluation (likelihood and severity), response plan and responsible person. All this information must be collected to facilitate the next phase of risk management: analysis and evaluation of identified risks.

To ensure that this identification phase is done with the least possible error, the methodology proposes a list of typical risks classified by the project phase in which they usually arise.

3.2.2.3. Risk analysis and evaluation. Risk analysis should not only be performed at the beginning of the project (at this time is essential), but also an update is recommended periodically if the project is long or if significant project changes take place.

The key tool in this task is the Failure Modes and Effects Analysis (FMEA), widespread in the industrial sector for the identification, evaluation and prevention of deficiencies in the design and manufacture of products. Many companies, including medium and small ones, are accustomed to it, but with a different purpose, so their inclusion in the project management can be simple.

This tool, when adapted to risk management, is a living document that contains almost all the information in a small space. On the one hand, the document contains the list of identified risks, prioritised after an evaluation based on impact and likelihood ratios, which will give the Risk Priority Index (RPI). On the other hand, it includes the strategy to maintain or reduce the index: actions to take, responsible and time. After taking action, there will be a reassessment of the risk impact and its likelihood.

A simple process consisting of two variables only is used:

- The materialising probability of a risk is analysed in terms of it being highly unlikely, unlikely, likely or highly likely.
- The gravity is analysed in relation to the impact of the particular risk on the achievement of project objectives, which may be negligible, significant, major or catastrophic.

Risk assessment is carried out based on its impact on costs, time and scope/quality, and the level or probability of occurrence. In both cases there are scales from 1 (negligible impact and highly unlikely occurrence) to 4 (catastrophic impact and highly likely occurrence). Likewise four categories of risk have been identified ranging from 1 to 60 (low risk), where no action is required, to 200–256 (high risk) where action will be essential.

The RPI index value is calculated with the following formula:

$$RPI = I \times P = (I_c \times I_t \times I_s) \times P$$

where:

I	Risk impact
I_c	Cost impact
I_t	Time impact
I_s	Scope impact
P	Risk probability.

Fig. 4 shows the relationship between the two factors (Impact and Probability) using a commonly used colour code in risk prevention.

In relation to these assessment criteria of severity and likelihood, the following actions are recommended for each level of risk:

- Acceptable risks: No specific actions to take. Only monitoring activities with indicators will be considered.
- Weak risks: Taking action is recommended to reduce the risk, in addition to defining monitoring indicators.
- Strong risks: It is recommended to act quickly in order to ensure project success, with risk management becoming a priority. It is important to reduce the likelihood or severity to make it at least a weak risk.
- Unacceptable risks: It takes major decisions, since otherwise the project is in serious danger of not achieving the strategic objectives.

3.2.3. Project execution and control

Following risk assessment and analysis, the project manager should establish action plans based on the recommendations for each level of risk, and prioritise the most important actions that would allow increasing the probability of project success.

The implementation of corrective actions must be immediate, adjusting budgets, checking resources and previous tasks, checking capabilities and obstacles on delayed tasks, including unplanned tasks, and correcting inappropriate ones or deliverables.

These actions will be reflected in the previously performed FMEA, thereby achieving a living document that supports the entire risk management process throughout the project.

3.2.3.1. Monitoring and control of risks' status. This activity includes reviewing operational risk indicators and periodically reviewing the project's strategic risks, already identified in the definition phase.

Some points that can give information on potential problems and should be revised periodically are:

- Tasks that cost too much time or money.
- Tasks that should have started and have not.
- Delayed tasks or tasks that should be completed but are not.
- Tasks performed but not planned.
- Tasks and deliverables that do not meet the requirements.

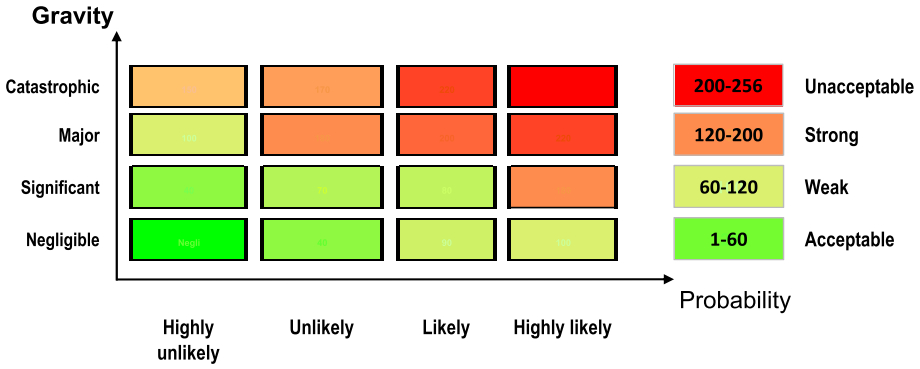

Fig. 4. Risk classification criteria.

The metric management is a tool that allows the detection of a future risk materialisation and the validation or not of the performed risk analysis. To effectively manage the risks of a project using indicators it is necessary to define:

- Risk indicator.
- Stability and danger margins.
- Review frequency.

As a general rule, indicators should be objective and easily obtained from available management tools to facilitate data collection and analysis. Experience shows that a small number of indicators should be defined. Between three and six indicators is enough in most cases. In no case it is recommended to define more than ten indicators. One should also be careful not to valuate indicators too frequently, because it can pose too much extra work to project management. The frequency should be related to the duration of the project and the gravity of the risk. We must, also, take into account that the project progress may not be linear and a high frequency can lead to obtain indicator values influenced by the project's progress picks. To avoid this, it is proposed to set upper and lower limits, within which action will not be considered.

Depending on the results of the indicator review, the following actions should be taken:

- Keep indicator management if the risk is controlled.
- Establish new action plans to minimise the risk if it is not controlled, affecting the risk factors (severity or probability), or the review frequency.
- Conduct further risk assessment on detection of an initially unidentified risk.

The methodology includes a checklist of indicators for some of the risks to be controlled. It also includes some templates that can assist in managing indicators allowing the seeing of the value's trend (i.e., collecting its evolution (numerically and graphically) along the project implementation).

3.2.3.2. Project risk communication. Risk communication within the project team is another task that is included in the project risks' execution and control phase. It is very important to define a simple communication system to inform the state of the tasks and deliverables. But risk communication is not reduced to a simple transmission of information. Risk management should be based on a strong communication, on relations based on transparency, trust and the right to make mistakes. It requires motivation and involvement of the whole team.

This task should facilitate the sharing of knowledge and experiences, generate awareness of risks throughout the project team and in-depth dialogue on their causes and consequences, as well as help create a climate of trust and cooperation, necessary for the success of a project.

The information must include, at least, the progress state of the project, relevant variations and corrective actions taken and their results. It must be accurate and frequent, focused on planning, cost, achievements and changes. It should always be compared with the reference planning.

The communication itself is not without its own risks, which need to be evaluated in the process' initial phase according to the characteristics of the team, the management and other factors.

The communication proposed in this methodology is done through the monitoring of indicators and updating of the risk FMEA.

3.2.4. Closure and final project evaluation

Project closure is an important part of risk management that is rarely performed. The closing of a project should always be defined so as not to lead to endless revisions by the customer, and always announcing that the project is officially over. A final meeting should always take place with the team to thank and recognise them, and to take note of all the ideas for improvement and lessons learned from it.

In this phase, common in all project management methodologies, we added an activity of project results management, both for commercially exploitable results (technical, production, results protection, etc.) and for non-commercially exploitable results (strategic and management skills). This task is not without its own risks, therefore a checklist is included in the methodology with the most common risks (see Annex II).

The main feature of the documents generated at this stage should be simplicity and applicability to other projects.

3.2.4.1. Project results management. The first step for proper results management is the identification of the technical knowledge generated in the project. It is necessary to analyse how to store this knowledge and whether its protection is possible, in order to disseminate it, either internally or externally. In the event that the results were obtained in collaboration with agents outside the company or in cooperation with them, we must work on strengthening the terms of the agreements between entities to take advantage of the cost and time involved and to provide, if so established, the possibility of enabling scientific or technological publications, which can help spread the competitiveness of the SME.

In all cases, the methodology proposes to materialise agreements through documents validated by different parties, in order to ensure the proper use of the results by whom it is entitled. It also allows control of the diffusion, which can generate a new market competitor or provide a solution that minimises the positive effect that the project may have on a potential competitor.

3.2.4.2. Lessons learned. For enterprises to effectively manage knowledge, it is crucial to record the various actions and take into account the project's experiences, in order to provide the basis for future planning of possible projects. The capitalisation and transfer of knowledge gained through projects is one of the most important tasks, as it helps the company to be successful in future endeavours. However, it is a task that is often overlooked because the project is considered finished and resources are immediately devoted to other operations.

It usually happens at the end of the project, at the last indicators' monitoring, acting where appropriate, through the integration of action plans in the chosen information collection system. Because learning actually takes place throughout the life of the project (definition, planning, execution and closure) the methodology proposes doing it during its course, and summarising it at the closing meeting to ensure no knowledge has been forgotten. The methodology includes a sample format for the collection of knowledge during the project, which will be accepted at the project closing meeting. Not only errors and their solutions should be collected but also success factors and best practices to repeat them in the future.

In summary, there is a table with a list of activities and techniques for each project's phase along with documents resulting therefrom (Table 2).

4. Discussion and methodology validation

In order to validate the project risk management methodology proposed, many implementations were necessary. The projects chosen were those that were going to be undertaken by some of the companies that have collaborated in the research. To this end, a methodological guide was designed, containing all the necessary information for a project manager to manage project risk: general concepts on project management, the new methodology, the implementation process, templates, checklists, etc.

The projects' life ranged from 9 to 18 months. The maximum budget rose to 263.000€ and the minimum was 12.000€. The project teams had an average of 4 people involved.

The implementations were carried out differently, depending on the particular characteristics of the projects' managers. Those with more experience in project management only needed an explanation of the methodology and specific assistance where needed. However, in those cases where the company staff did not have the necessary training, the research team applied the methodological guide. In one case, the use of the guide was entirely done by the company, without consulting.

The purpose of these implementations was, first, to assess the applicability and usefulness of the methodology. Later, we wanted to know if the non-use of all tools was due to the lack of understanding, to the disconnection between the company's needs and the proposal made, or to incorrect user application.

4.1. Methodology implementation phases

Once the companies and projects were chosen and their collaboration confirmed, work was planned according to the steps shown in Fig. 5.

The five implementations of the methodological guide proposed allowed the collection of a large number of improvements ranging from conceptual aspects to graphical aspects in the proposed templates.

Table 2
Phases, activities, techniques and documents resulting from project management methodology in SMEs.

Phase	Activities	Techniques	Documents
Definition	Strategic risk analysis and evaluation	Strategic risk checklist	Initial risk evaluation
Planning	Risk management planning	Planning template	Risk planning
	Operational risk analysis and evaluation	Phase risk checklist FMEA	Risk FMEA
	Indicators' definition	Indicators' checklist	Indicators' list
Execution & control	Indicators' revision	Indicators' list	Updated indicators' list
	Correcting actions	Risk planning	Updated risk planning
	Strategic risk review	Strategic risk checklist FMEA	Updated risk FMEA
Closure	Project closure decision	Meeting Checklist of risks associated to results management	Project results report
	Closure report approval	Lessons learned template Meeting	Lessons learned

In order to obtain a feedback on the methodology, the generated documentation during the implementations was analysed. Much of the information about the guide, the usefulness of the methodology and tools, the applicability in different companies, missing aspects and difficulties encountered in the implementation, were collected in the same templates used in the process as notes, and are usually handwritten. However, at the end of the projects, a meeting with project managers was held to get a final overall assessment, providing also the perspective of the finished work. There were discussions about how they would like the process to be the next time and about finding out how the guide had helped achieve project success and, in particular, keeping risks under control.

Both the methodology and the guide generated for its implantation have been updated and the improvements and changes collected for each phase have been included.

Table 3 summarises the results of the various aspects of the implementations including the characteristics of the firms and the project, details of how the implementations were carried out and the main difficulties found in the process. Also, an evaluation of the methodology with the benefits and usefulness is contained.

4.2. Results' discussion

Project managers who used the methodology and had some previous experience in project management reported fewer problems arisen than in previous cases, and that the time spent in the application of the guide was worth the results.

The time spent in the use of the methodology never exceeded 85 h. The relationship between this time and the project time was a 3.77% (considering 20 days/month and 8 h/day of project work). This percentage increases as the duration of the project shortens. This is due to the fact that the initial tasks (definition and planning) and final tasks (learned lessons and results management) are the most time consuming and are independent of the duration of the project. The activities defined in the execution and control phase took comparatively less time than the previous ones.

The initial premise for the design of the methodology was the need to manage risks, considered as one of the project management areas less applied in SMEs. However, after its application, the methodology proved to be helpful not only for managing risks but also for the management of many of the other knowledge project management areas. For example, introducing the risk checklist, with some like “There is no project budget” or “There is no project schedule”, encouraged the project manager to perform all essential processes in any project, whatever its size.

The methodology was applied in all the phases of the project. There were no specific problems associated with a particular phase. The phase that more effort was required was the definition phase. This was due to both, its innovative character and the difficulty of project teams in doing a strategic analysis of the project.

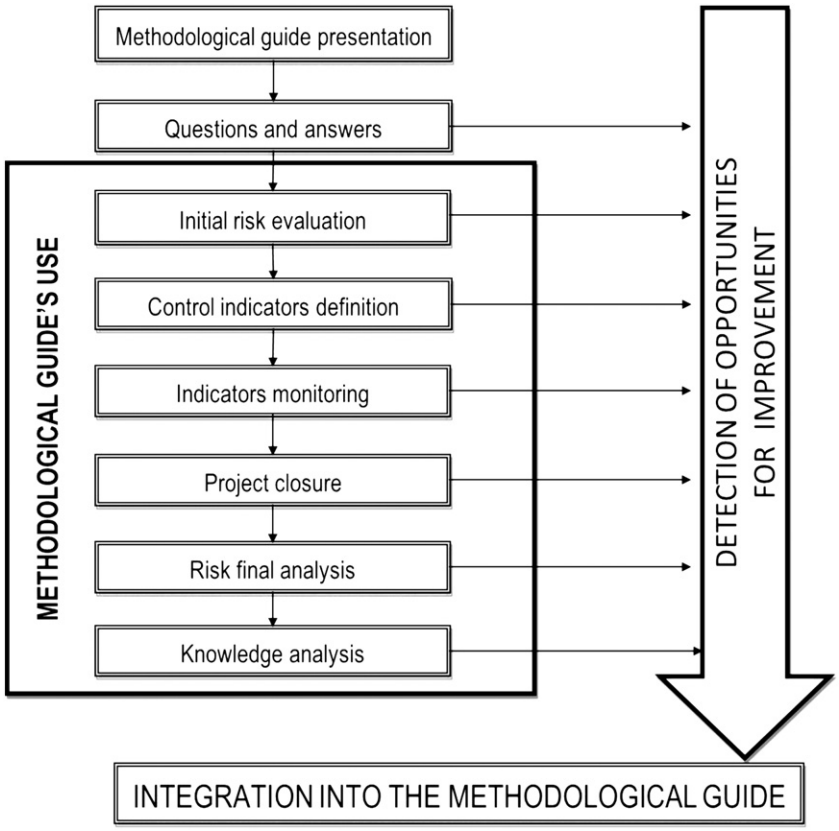

Fig. 5. Implementation process of the risk management methodology on real SMEs’ projects.

Table 3
Methodology implementation results.

		Project 1	Project 2	Project 3	Project 4	Project 5
Company	Staff	7 people	140 people	2 people	5 people	14 people
	Revenue	<5 M Euros	<5 M Euros	<2 M Euros	<2 M Euros	<5 M Euros
	Size	Micro	Medium	Micro	Micro	SME
	Sector	Energy services	Consultancy	Car industry	Electronic	Mechanic
	Certified management systems	ISO 9001: APPLUS	ISO 9001: BVQI	N/A	N/A	N/A
Project	Type	R & D	Management systems	ICT	Management systems	Management systems
	Objective	Design of a device for heating system management	Certification to the standard UNE 166002	Implementation of a management system integrated in stock management	Innovation project management and documentation	Development of a documentation management system
	Time	18 months	1 year	1 year	3 months	9 months
	Budget	263.100 Euros	18.600 Euros	32.000 Euros	12.000 Euros	26.000 Euros
	Project staff	5 people	5 people	2 people	4 people	3 people
	Responsible for the implementation	Manager	Systems manager	Manager	Manager	Production manager
	Previous project management	Yes	Yes	No	No	Yes
	Previous risk project management	No	No	No	No	No
	Researcher's participation	Initial support and questions	Initial support	Initial support and questions	Total	None
Guide implementation	Time of guide's use	70 h	85 h	45 h	25 h	64 h
Implementation valuation	Difficulties	Work system visualisation: sequence and tools Visualisation of RPI values that need action Indicators' definition Indicators' monitoring Lessons learned	Initial definition of a great amount of indicators	Incomplete initial definition of the project Difficulty with communication between the project manager and an external person Supplier activity control Reaction to the change of the company's manager	Psychological barriers due to previous negative experiences Subcontractors' control	Supplier activity control
	Improvements to the methodological guide after valuation	Creating a work scheme Checklist update Templates' improvement 1. Checklist: Graphic display of the state of milestones 2. FMEA: Automatic range of colours depending on the IPR 3. Indicators' monitoring	Inclusion of a recommendation on the maximum limit of indicators to be defined and their revision's frequency Introduction of paragraphs in the templates to collect important facts	Updating of the initial checklist to include a "green light" to start a project Inclusion of annotations in the guide on the importance of periodically reviewing strategic risks throughout the entire project life	Introduction of a control parameter concerning negative past experiences	Updating the initial check list to include an assessment of activities' effectiveness to achieve the objectives Recommendations on how to improve staff motivation Improved indicators' track format
	User's guide valuation: benefits and usefulness	Easy to use Positive feedback as it allows the elimination of strategic risks and the correct definition of objectives Its utilisation needs few resources.	Practical and easy to use. Good integration with the existing management system without discrepancies	FMEA provides information in a simple way. Encourages the study of the project's strategic rationale	Easy to understand The analysis of the information is quick and visual. The outsourcing aspects must be analysed. The methodology must include specific tools for outsourcing processes.	Using the methodology allowed the detection of serious shortcomings in the project definition. The guide is found simple to use as it included known techniques (FMEA, IPR and PRL).

Some other positive effects of the methodology were the following:

- It allowed the elimination of strategic risks and the correct definition of objectives, eliminating serious shortcomings in the project definition.
- It allowed obtaining rapid and visual information about the status of the project risks in facilitating the decision making.
- The templates proposed were useful and simple to use.

The results of these case studies support the conclusions of Kerzner (2003):

> *'….Even the simplest methodology, if accepted by the organization and used correctly, can increase your chances of success'*

> *'…The ultimate purpose of any project management system is to increase the likelihood that your organization will have a continuous stream of successfully managed projects. The best way to achieve this goal is with good project management methodologies that are based upon guidelines and forms rather than policies and procedures.'*

The guide was understood and used with relative ease when managers had prior knowledge on management, even when not specific to project management. Moreover, there were no conflicts detected when applied in companies with previously certified management systems. The critiques and suggestions from people who used the application guide, improved its design and content. The final aim is to give the project manager training so the methodology can be applied in the future autonomously.

Most of the improvements were included in the checklists and templates, (in content and format): graphic display of FMEA and indicators, updating the initial check lists, new recommendations and information about indicators, etc.

The indicators' definition proved to be the most difficult task for project managers. In project management, we often identify metrics that cannot effectively predict project success and/or failure. Some typical causes of metric failure in project management include: (1) performance is expressed in traditional or financial terms only, (2) the use of measurement inversion, using the wrong metrics, (3) no link of performance metrics to requirements, objectives and success criteria, (4) no link to whether or not the customer was satisfied, and (5) lack of understanding as to which metrics indicate project value (Kerzner, 2011).

The main problem that project managers found was applying the methodology in the outsourced tasks of the project. The difficulty has been found in defining indicators to control the outsourcing suppliers, and also in measuring them. This problem had been identified by Abdullah and Verner (2012). They affirm that risk analysis rarely flows into outsourcing. Future research needs to be done to evaluate if this is a guide issue or if it relates to the implementation, and in any case correct this deficiency including additional sets of outsourcing risks that have been identified by Taylor (2004, 2005, 2006, 2007) and Iacovou and Nakatsu (2008) under the vendor perspective. Other difficulties that the Project managers found are related to the right definition of the objectives, the control of the external suppliers' activities and the communication with external stakeholders.

After having analysed the initial risk evaluations of the all implantations, the need to re-define the ranges of action depending on the RPI index has been identified. If the time impact and occurrence are at the highest level (4) but the others are low (1 or 2), the RPI index would reach a value between 16 and 64 (acceptable or weak risk). Likewise, a risk of maximum impact (4) in all the aspects (cost, time and scope) but of low probability (1) would also obtain a weak risk valuation. These values, applying the initial criteria, wouldn't bear any action strategy. Nevertheless, in the practice, it would be necessary to establish some action that controls the appearance. This aspect is being modified by introducing decision tables based on several parameters, and not only in the value that reaches the RPI index. These tables will be validated in future implantations.

The methodological guide is obviously, open to new changes and future enhancements according to the new needs detected in companies. Though we have not observed motives that should suggest that the methodology could not work in other countries, we expect to be able to prove the methodology in other countries to verify its applicability in different economic and cultural environments.

5. Conclusions

The main contribution of this research is a project risk management methodology, specific to SMEs, which helps with the strategic project formulation, and is validated through the successful implementation of each of the proposed tools and activities.

A field study was carried out in collaboration with several industrial and service companies of a wide range of business activities, who managed projects, often traumatic, from which we obtained very valuable information to confirm the data obtained in the literature research and define their specific needs.

This methodology is applicable to all project phases and is adaptable to different types of projects and companies. In addition, it uses few resources, does not require specific training, provides information for decision making and integrates knowledge and results management.

The method provides an overview of the project with the basic balance between results and limitations. It allows the generation of the necessary information to ensure communication and lessons learned, not to fall back into the same mistakes and issues.

It includes tools characterised by their simplicity and ease, such as checklists, templates, FMEA and indicators; and allows flexible and adaptable management.

It is also important to note the good reception by project managers that have participated in the second phase of the field study. Several agreed upon the application of project management

tools that facilitate efficient and non-traumatic realisation of projects. They considered the methodology as a way to approach both knowledge and resources available in a large size company.

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