IT innovation strategy: managing the implementation communication and its generated knowledge through the use of an ICT tool

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Abstract

Purpose – *Without effective implementation, no information technology (IT) strategy can succeed. There has been much re-search into IT planning, but few studies have developed one of the most important phases of IT strategy: IT Implementation. IT implementation can be improved at information and communication technology (ICT) organizations through the use of organization learning models (OLM) and the implementation of ICT tools. This paper has two purposes define an OLM framework that determines the best practices to increase knowledge at individual, group and/organizational levels, and define and implement an ICT tool to facilitate the integration and institutionalization of the OLM. The ICT tool is based on the technology roadmapping technique that allows an organization to manage at an executive level what, when and how the IT strategy is going to be implemented.*

Design/methodology/approach – *This paper is based on a case study performed at an ICT organization that provides ICT services to financial institutions. The study was carried out in 2014. It analyzed over 24,000 projects, which translated into an equivalent of more than 18 million man-hours. The proposal was assessed at a very large ICT organization.*

Findings – *This paper proposes a framework called SPIDER to effectively implement OLMs based on Big Data management principles for monitoring and reporting current status of IT innovation strategies. These kinds of approaches contribute to solve the problems identified in the state-of-the-art regarding the communication and monitoring the implementation status of IT innovation strategies. During this research work, several factors that are essential to implement these kinds of approaches in large banking organizations were identified: effort required to elaborate the monitoring and reporting activities; easiness to understand the reported information; detailed planning of the implementation program; and focus on communication efficiency.*

Originality/value – *This paper determined the best practices to manage knowledge generated during the implementation of an IT strategy. Additionally, this paper defined and implemented an ICT tool to properly communicate and monitor the implementation of an IT innovation strategy, based on technological roadmap techniques.*

Keywords *Communication, Technology roadmap, IT innovation strategy, Organizational learning model*

Paper type *Research paper*

1. Introduction

The fact that organizations are faced with a proliferation of data and focus on investing in "Big Data" and "data analytics", Laney (2013) and Vera-Baquero *et al.* (2013) point to the need to better understand how these sources of data and information can promote learning, efficiency and effectiveness (Jenkin, 2013). Thus, organizations are demanding more efficient information management technologies to support their business activities (Lucio-Nieto *et al.*, 2012). Because of this, information technology (IT) services are

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becoming crucial, and their management and improvement are an up-to-the-minute management concern (Lema *et al.*, 2015). In addition, information and communication technology (ICT) tools may be useful in supporting other learning processes at the individual, group and organizational levels (Jenkin, 2013). Soto-Acosta *et al.* (2014a), Andreeva and Kianto (2012) demonstrated that a proper ICT tool supports and influences knowledge acquisition, dissemination and utilization.

This paper is focused on improving the organizational learning model (OLM) (Crossan *et al.*, 2011) and improving the implementation of IT innovation strategies at ICT organizations, both in terms of monitoring and communication. An IT innovation strategy is a corporate strategy that uses IT as its core to support and enable major economic activities performed by the firm (Dehning and Stratopoulos, 2003; Heart *et al.*, 2010). The main purpose of an IT strategy is to ensure the efficient and effective implementation of the development project portfolio (Mocker and Teubner, 2005). According to Bartenschlager and Goeken (2010), a strategy cannot be successful if there is no an effective procedural knowledge (Bennet and Tomblin, 2006) for implementing it.

Studies show that IT-strategy implementation is important because (Bartenschlager, 2011; Bartenschlager and Goeken, 2010):

- Failure to carry out IT strategies can result in lost opportunities, duplicated efforts, incompatible systems and wasted resources.
- Lack of implementation leaves firms dissatisfied with and reluctant to continue their strategic planning.
- Lack of implementation creates problems with establishing and maintaining priorities in future IT strategies.

This research work has its origin in the strategic business unit (SBU) of an ICT company named ABC (fictional name) that needed to increase its knowledge capabilities (Revilla *et al.*, 2009) and improve the communication and monitoring of the implementation of their IT innovation strategies. ABC belongs to a financial group, and it provides ICT services to over 80 financial companies in more than 10 countries. In 2014, over 24,000 projects, translated into an equivalent of more than 18 million man-hours, were carried out. The ICT organization has 14 business units and a headcount of approximately 11,000 with a base cost of over €1,000mn. Since 2004, ABC has implemented IT innovation strategies in 12 banking organizations (Huber, 2009). In 2013, within the scope of this activity, ABC executed 12,000 projects considered (as) "Process Change" and/or "Transform the Business" (Hunter *et al.*, 2008). These projects were related to components' development and integration that were part of the large IT innovation initiatives carried out by some financial entities that ABC supports.

According to Bartenschlager and Goeken (2010), Brown and Brown (2011), Waweru (2011), Gottschalk (1999), Elysee (2012), there is a need for more research regarding the improvement of the implementation of an IT innovation strategy. Despite the great interest in implementation as a crucial role, empirical studies show that most IT strategy implementations fail (Bartenschlager, 2011; Yeh *et al.*, 2012). Hrebiniak (2006) concluded that without effective implementation, no business strategy could succeed. Some of the barriers to strategy implementation identified by Hrebiniak (2006), Alamsjah (2011) include:

- poor or vague strategy definition;
- poor collaboration or inadequate information sharing or knowledge reusing;
- no procedural knowledge (guidelines, models, etc.) available to support the implementation process;
- weak or inadequate communication within an organization;

- great difficulty to elaborate and communicate relevant information to stakeholders; and
- unclear responsibilities within the implementation process.

This research work is focused on effective approaches to communicate the current state of implementation of an IT innovation strategy that is essential in achieving competitive performance (Wu and Chiu, 2015). One of the factors that prevent the success of IT innovation strategies is the lack of an OLM to manage the knowledge needed to monitor and communicate the implementation of an IT innovation strategy. An approach to communicate the current state of an IT innovation strategy should provide a clear method for planning implementation and communicating it (Brown and Brown, 2011; Shu, 2008), promote organizational learning (Yeh *et al.*, 2012; Bennet and Tomblin, 2006; Stata and Almond, 1989), determine well-defined milestones and standardize the progress/performance measurement (Cabrey and Haughey, 2014).

To address the communication problems to report the current state of the implementation of IT innovation strategies in large finance organizations, the following questions were stated at the beginning of this research work:

Q1. How to implement an organizational learning model to manage the knowledge required to communicate and monitor the implementation of an IT innovation strategy applying Big Data management principles?

Q2. What are the factors that contribute to an effective implementation of Big Data-based approaches to manage the knowledge required to monitor and communicate the current status of IT innovation strategy implementation?

To discuss and solve the ABC problem through the analysis of previous questions, several specific objectives were identified in the scope of this research initiative:

- Define a framework for communication and monitoring the current implementation status of an IT innovation strategy-based on Big Data technologies. The definition of this framework will be completed during the implementation of an IT innovation strategy in ABC.
- Determine the effectiveness of ICT tools and its components to communicate and monitor the implementation of an IT innovation strategy at a financial organization.

The rest of the article is structured as follows: Section 2 briefly reviews the background related to this work. Section 3 presents the approach adopted to define the practical framework to communicate and monitor an IT innovation strategy. Section 4 describes briefly the main components of the framework defined that is named as SPIDER. Section 5 presents the results obtained from the assessment of SPIDER effectiveness in the scope of the case study. Moreover, the factors that influence in the SPIDER framework implementation are enumerated in this section. Section 6 discusses how the SPIDER implementation contributes to solve some of the problems related to the implementation monitoring of an IT innovation strategy. Finally, Section 7 presents the conclusions obtained from this research work.

2. Background

This research work focuses on applying OLMs and ICT tools to manage the knowledge related to monitoring and communicating an IT innovation strategy. It addresses the call for determining the main approaches for monitoring and communicating the implementation of an IT innovation strategy, as well as determining the use of an ICT tool along with the available massive corporate information to manage the implementation of IT strategies, and determine the most relevant problems.

The implementation of an IT strategy can be defined as the process of completing the activities/processes and IT projects to assist an organization in realizing its goals (Bartenschlager, 2011). According to Bartenschlager (2011), a strategy implementation approach requires two important components – guidelines and techniques – to support the

overall implementation process. Both components must have a set of features that was determined by Bartenschlager (2011) (Table I).

But even with having available the mentioned components, the main problem is that managers focus more on strategy formulation than implementation (Waweru, 2011). Senior executives often struggle to bridge the gap between formulating strategy and actually implementing it (Cabrey and Haughey, 2014). According to PMI (Cabrey and Haughey, 2014), the primary factors for failure in the implementation of strategic initiatives are insufficient communications (59 per cent) and lack of commitment by senior management (56 per cent). The communication issue is related to the need for a clear method of communication (Brown and Brown, 2011; Shu, 2008), well-defined milestones and objectives to measure progress (Cabrey and Haughey, 2014), established and reported specific ownership and accountability (Bartenschlager, 2011; Gottschalk, 1999). The commitment issue is related to the involvement of C-Suite (only 25 per cent) in the monitoring of the strategy (McKinsey, 2006). To increase engagement, senior managers need "distilled" information so that they can readily understand the progress or any emerging and/or urgent problem, limiting overwhelming amounts of information to only the most critical milestones, risk, interdependencies and objectives. Basahel and Irani (2010), Brown and Brown (2011) conclude that top management's commitment is crucial to implementing IT strategic plans.

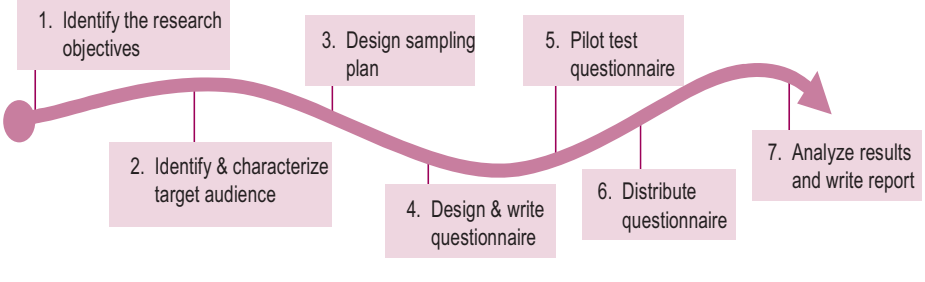
Regarding the must-have features of the IT strategy implementation components, Figure 1 summarizes the literature review performed by Bartenschlager (2011).

Table II provides some inferences, for instance, Methods Engineering exists in most of the proposals providing a structured and logical approach to IT strategy implementation, conspicuous exceptions efficiency and flexibility. This is because efficiency cannot be

Table I Features of the components to implement an IT strategy

Feature	*Description of requirements*
Method engineering modules	Is the approach comprehensive (in terms of method engineering) and comprise a process model, activities, techniques, roles and results?
Effectiveness	Does the approach support a structured and targeted course of action?
Efficiency	Is the approach efficient from an economic perspective (e.g. amount of steps and resources needed)?
Ease of use	Is the approach easy to understand and therefore useful for practitioners?
Flexibility	Is the approach useful for different situations and therefore customizable?
Logic	Is the approach logical?
Implementation Planning	Does the approach consider activities for planning and detailing the implementation as well as controlling it? Are any guidelines given?
Communication	Does the approach account for any specifics on information technology and its implementation? Does the approach specify any communication activities and/or techniques?

Figure 1 Interviews process



Source: Kasunic (2005)

Table II Analysis of approaches to implement IT innovation strategies

Feature	*Salmela and Spil (2002)*	*Min* et al. *(1999)*	*Mentzas (1997)*	*Littler* et al. *(2000)*	*Kovacevic and Majluf (1993)*	*Noble (1999)*	*Shu (2008)*	*Chew and Gottschalk (2009)*	*Pearce and Robinson (2007)*	*Cassidy (2006)*
ME components (overall)	O	O	O	O	O	O	O	O	O	O
Effectiveness	O	O	O	X	O	–	–	O	–	O
Efficiency	–	–	–	–	–	–	–	–	–	–
Ease of use	O	X	O	O	O	O	–	–	–	O
Flexibility	–	–	–	X	–	O	–	O	O	–
Logic	X	X	X	O	X	O	X	X	O	O
Implementation planning	O	O	O	X	–	–	X	O	X	–
Communication	–	–	–	O	–	O	X	X	–	X

assessed *a priori* in the following sections. This study analyzes these features by comparing the present situation with the proposal included in this paper. Another aspect that arose was the implementation planning, and even though it is a studied problem, most authors do not focus on it. It also seems that most approaches in the IT domain do not take into account the role of communication at all. The authors coincide with Bartenschlager (2011) about the need for a more detailed focus on existing problems in the practice regarding IT strategy implementation. Based on that, this study details the required components (guidelines and techniques) to monitor and communicate the implementation of an IT strategy.

Regarding the second point on massive information and ICT tools, there has been much research attention on implementation planning (Brown, 2004; Bartenschlager, 2011), and the authors will focus on the implementation reporting, by defining the components that provide (Hrebiniak, 2006) a clear sequence of changes or a "roadmap" with clear, defined, logical structure of the IT strategy implementation. Phaal *et al.* (2000) developed a high-level integrated planning technique named "technological roadmap" (TRM) which can be used to communicate (Talonen and Hakkarainen, 2008) a strategy implementation and a knowledge management tool (Brown and Hare, 2001; Guo, 2010). TRM is one of the most widely used methods to support innovation and strategic management of technology (Lee and Park, 2005; Phaal *et al.*, 2003a, 2003b, 2004; Whalen, 2007). According to Phaal and Muller (2009), a TRM has four layers: market, business, product and technology. This research paper details the last layer (technology) to show the executive level that a set of milestones and work streams will conform to the "roadmap", allowing the teams to understand what the strategic objectives are, where we are going, how to get there (Talonen and Hakkarainen, 2008), what the prediction of achieving the committed date is, by means of graphs that allow the visualization, communication and understanding of the plan provided.

According to Soto-Acosta *et al.* (2014), Palacios-Marqués *et al.* (2015), the transfer or creation of knowledge takes place through the interactions and collaboration (Lee *et al.*, 2012) of the organizational and non-institutionalized actors (de Kervenoael *et al.*, 2015). TRM interacts with the different levels of the OLMs (Guo, 2010) and promotes the use of its essential capabilities (Crossan *et al.*, 2011): exploration and exploitation (Bennet and Tomblin, 2006; Revilla *et al.*, 2009). Exploration includes activities such as search, experimentation and discovery, while exploitation involves imitation, refining and adapting existing knowledge (Taminiau *et al.*, 2010). To facilitate exploration, the authors consider that during the monitoring of an IT strategy, the individual should have the option to trigger intentionally or automatically (Jenkin, 2013), whichever the option is best suited, reusing all the available massive information related to projects and their components to increase the success of a strategy implementation. This is possible because most companies store their project performance data and/or the lessons learned (Maqsood *et al.*, 2006), and are waiting to be used during the realization of the new projects. This information can be used in the form of predictions and estimations for attaining milestones, risk mitigations and so on.

Finally, this paper will describe an OLM supported by an ICT tool that will include some artificial intelligence features (Edwards *et al.*, 2005) such as data mining. The ICT tool will support the definition and implementation of a TRM to solve some of ABC's elicited problems associated with the communication/monitoring of an IT strategy implementation. The ICT tool will provide the required components (a guideline and a technique) and must satisfy the features determined by Bartenschlager (2011).

3. Defining the components for implementing an IT strategy

A qualitative case study was implemented to achieve the goals stated for this research work.

In this case, qualitative case study methodology is an appropriate approach because it provides tools for researchers to study complex phenomena (the analysis of factors to

control and communicate appropriately a IT innovation strategy) within its contexts (the IT innovation strategy implementation in large banking companies). When the approach is applied correctly, it becomes a valuable method to evaluate programs and develop interventions, as it is necessary to achieve our research goals (Baxter and Jack, 2008).

The research question driving the implementation of the case study is how to implement an effective framework composed of effective practices supported by Big Data-based tools to monitor and report to the C-Suite the current implementation status of an IT innovation strategy in a large organization. Another research question related to this case study consists of identifying the factors that influence the effective implementation of knowledge-based technology frameworks to support the monitoring of IT innovation strategies.

According to Yin's (2003) recommendations, an explanatory case study was implemented to explain the presumed causal links in real-life interventions that are too complex for the survey or experimental strategies. In evaluation language, the explanations would link program implementation with program effects.

The intervention consists of the definition and implementation of a framework, named as SPIDER, to monitor and report the current implementation status of an IT innovation strategy.

The context of the case study consisted in defining and implementing an IT innovation strategy in the area of products related to life and casualty insurance. Initially, the business imposed the dates on which the products required needed to be delivered. The products were:

- life assurance products for individuals;
- life assurance products for groups; and
- casualty products for individuals.

At ABC, the insurance's SBU took the responsibility of implementing such a strategy due to its importance.

The individuals involved in the case study were in charge of monitoring and periodic reporting of the current state of the IT innovation strategy based on the implementation and improvement of the SPIDER framework.

The approach to implementing the case study mentioned is summarized in Table III.

3.1 Initiation phase

The purpose of this phase was to establish the knowledge management (KM) and communicating practices and define the scope of the ICT to support the implementation of an IT innovation strategy as well as to plan and structure it.

The participants in the Planning phase were the managers responsible for implementing the IT strategy, several senior managers and two members from IT methodology department. The strengths identified were the existence of extensive knowledge and expertise of the persons consulted about coordinating and planning several transformation projects that were conditioned by overly aggressive milestone dates. To achieve those IT strategies, in most cases, it was necessary to stress the plan, identify coordination points and determine the risks associated. With respect to the weaknesses identified, there was a lack of a standardized and formalized process to guide the implementation of IT strategy, but a "*de facto*" roadmapping technique was found that was elaborated manually, and its use was mandatory, generating outputs that were reviewed at every IT strategy status meeting. The outputs represented the planning to implement the IT strategy using simple graphs. Following this analysis, the participants in this phase contributed to compile procedural knowledge about the implementation of an IT innovation strategy. Finally, the roadmap to implement the IT innovation strategy was presented and approved by the insurance SBU management committee.

Table III Approach to implement the mentioned case study

Phase	*Initiation*	*Development*	*Evaluation*
Activities	Identification of strengths and weaknesses related to the implementation of IT Innovation Strategies Create an IT innovation team Collect PMO reports, *ad hoc* presentation to communicate and monitor the implementation of an IT strategy Elaborate the implementation plan	Develop and build the artifacts Carry out sessions to review the progress Introduce changes in the initial artifacts to communicate and monitor the implementation of the IT innovation strategy	Identify the requested audience Identify questionnaire objectives Carry out communication and change management sessions Design and write the questionnaire Test the questionnaire during an interview Interview the individuals from the required audience
Duration	M0-M1	M2-M8	M9-M11
Participants	Senior Insurance Managers IT Methodology Manager	Senior Insurance Managers IT Methodology Manager	Senior Insurance Managers IT Methodology Manager
Results/ Outcomes	Needs regarding communication and monitoring of an IT innovation strategy were stated An initial set of communication and monitoring artifacts was defined The team to define, develop and implement the project was created The plan to implement the artifacts was created and approved	The set of communication and monitoring artifacts was built and periodically reviewed The degree of use of communication and monitoring artifacts was determined The opportunities for and improvement to the proposed set of communication and monitoring artifacts were documented	The information from (related to) the questionnaires was collected A statistical analysis of the features related to the implementation of an IT Innovation strategy was performed A general conclusion was elaborated and published for the Senior Managers

Note: PMO = project management office

3.2 Development/collection phase

The purpose of this phase was to adapt existent guidelines to plan, organize, budget and implement an IT strategy.

At the beginning of this phase, to determine the SPIDER features, it was necessary to analyze and review different innovation management models and governance frameworks.

Additionally, during this phase, an ICT asset was built to create and generate TRMs associated with an IT Strategy. This ICT asset used the information pertaining to the enterprise project management (EPM) tool. Using the available information, various analyses and predictions were performed to obtain value-added information such as IT strategy implementation status, risk level, consistency and coherence of the projects planning. All this information was condensed and summarized in a no more than two slide presentations. The result was reviewed weekly, and this allowed exchanging implicit and tacit knowledge. The review included the analysis of the critical path, stressing planning opportunities, milestone precedence relations, reviewing/confirming the customer agreed delivery date of the main deliverables, etc. The participants in the development phase were a Project Management Office (PMO) Resource, two members of the IT methodology department and several senior managers.

3.3 Evaluation phase

The purpose of this phase was to collect user experiences and lessons learned through the use of processes and artifacts; summarize its potential benefits; and determine, along with the Insurance SBU and ABC senior management, the possibility of extending the implementation of the process and the use of SPIDER across the organization.

The specific objectives stated for the evaluation phase were:

- Assessment of effectiveness of the SPIDER framework to monitor and communicate the implementation state of an IT innovation strategy.
- Assessment of the enablers needed to implement the SPIDER approach properly.

The method used to achieve the research objectives included a structured interview ending with a survey because, when done correctly, generalizations can be made from many people's views by studying a subset of these.

At each of the meetings, some surveys were distributed and these provided some data that were further analyzed using several statistical techniques.

According to Kasunic (2005), the process used to implement the survey is shown in Figure 1.

The questions that guided the design and analysis of the survey are given in Table 4.

The survey items were measured based on multi-scale values and the Likert scale of 1 (total disagreement) to 5 (total agreement). Before starting the analysis, a normality test was performed, resulting in the distribution of the variable analyzed having the characteristics of a normal distribution.

The professionals interviewed included the head of the insurance SBU, the IT directors and other managers. The professionals selected have extensive knowledge and experience in project management, PMO and IT transformation projects. The size of the population surveyed was $n = 26$, which is a representative sample based on a sample calculation using a *t*-Student with a confidence level of 90 per cent and a margin error of 15 per cent.

The characterization of the professionals surveyed is summarized in Figure 2.

4. SPIDER framework definition

This research aims at defining and implementing a framework called SPIDER that defines an architecture of technological components based on Big Data and organizational learning technologies and a set composed of effective practices for its application to provide C-suite of a large company actual information of the current implementation status of an IT innovation strategy.

The main features of SPIDER framework are:

- Provision of effective mechanisms to acquire massive information of the current status of the large amount of development projects carried out in the organization to implement the IT innovation strategy. This information is obtained from the different technological platforms and tools used through the company to manage individual projects.
- Implementation of mechanisms for automated organization of information in relation with

Table IV Survey questionnaire

Feature	*Question*
ME modules	What is your assessment about the processes and tools currently available to manage plans?
Effectiveness	Do you consider that the TRM would be effective to plan and communicate technological plans?
Efficiency	Do you consider that the TRM would be efficient to plan and communicate technological plans?
Ease of use	What is your assessment regarding the ease of communicating a plan by using the TRM technique?
Flexibility	Do you consider the TRM a flexible technique?
Logic	Do you consider that it is logical to communicate a plan through the use of a TRM?
Planning	Do you consider that TRM could be used for planning the implementation of a technological plan?
Communication	Do you consider that the TRM is a more effective medium to communicate plans than existing PMO reports?

Figure 2 Demographic information

the strategic goals included in the IT innovation strategy to provide a consolidated and a drill-down view of the current status of implementation of each goal.

- Provision of relevant information regarding the current status of implementation to the C-Suite in a graphical way using the program implementation schedule as basis for the representation.
- Inclusion of added value information for decision-making regarding probabilities of goals achievement in a period and risk prediction through the use of massive information about projects components stored in historical databases.

The value of SPIDER relies on its ability to summarize visually the IT strategy implementation plan by focusing on the work streams and a limited set of business and technical milestones. At ABC, SPIDER was generated using the information pertaining to the EPM tool and resulted in an output graphical representation of the IT implementation plan.

Figure 3 depicts a three-tier scheme that represents the framework architecture. Information flows through the proposed framework. First, the information regarding the definition of the program to implement the IT innovation strategy is obtained to facilitate a meaningful representation of the strategy implementation status. During the projects execution, the operational information is acquired from the projects. Periodically, when control activities are implemented, the SPIDER maps the operational information to the IT innovation strategy goals and reduces this information to provide a view appropriate for implementing strategy management activities. Finally, this information is compared with other historical data to facilitate prediction and decision-making at strategy level.

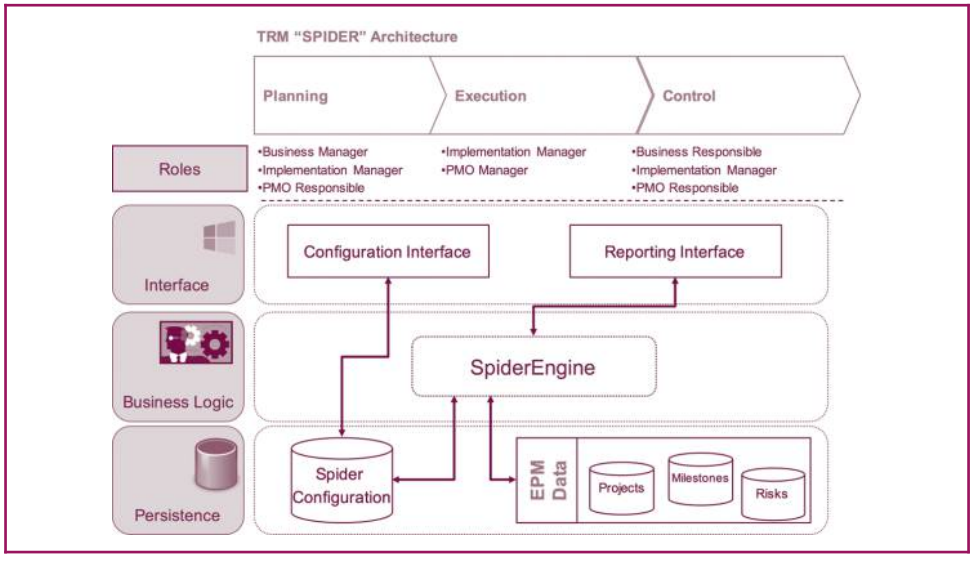
The main steps required for the SPIDER adaptation are described below.

4.1 Implementation planning

The first step to implement the SPIDER approach consists of defining the program, the key elements of a SPIDER Roadmap are determined, which means the "*Why*", "*When*", "*What*" and "*How To*". The next step is linking those resulting drivers, starting from the *When?* And going through the Domains "*what has to be done?*" and finally reaching to the value streams (Dissel *et al.*, 2009) "*how to do it?*". Value streams compose each domain; each value stream represents a work stream formed by one set of activities or phases (i.e. definition, development and deployment). At this moment, the program definition is formalized through the identification technology development projects. These projects will provide the SPIDER Roadmap feeding information, and relate each project to a critical milestone and a value stream. During this phase, the determination of interdependencies among the projects is stated for each critical milestone and value stream level.

The elaboration of a SPIDER Roadmap requires several loops for refining and reviewing internally the "right picture". A preliminary version of the SPIDER Roadmap will be generated and subsequently refined and, due to planning inconsistencies, stress planning or coordination requirements. Establish and communicate the project reporting and SPIDER monitoring criteria. This activity allows determining the technical and non-technical enablers and barriers. It is also necessary to ensure whether the underpinning SPIDER is

Figure 3 SPIDER architecture



sufficiently clear and contains the necessary and adequate information for senior managers to be able to determine the IT innovation strategy global status, assess the impact of events and new information on the plan as a whole.

Once a coherent version is obtained and is reviewed and accepted by senior managers, an official SPIDER Roadmap version is published. This step is essential to ensure that the resulting TRM contains the "right picture" to communicate the IT strategy and to confirm that business expectations are attainable.

Along with the SPIDER Roadmap, the IT strategy investment budget has to be determined, as well as a rough estimation of every project and an IT strategy investment (ITSI) responsibility matrix.

4.2 Implementation execution

During this step, the information of the current state of each development project is collected from the EPM system to manage each of them.

Based on the associated set of projects during the SPIDER configuration, reported information is imported from the corporate EPM, which includes project, milestone, grade of advance and risk.

Using the collected project information and the SPIDER roadmap configuration, the current state report is generated by using an engine that "distils" the information gathered. When creating the SPIDER, it is possible to generate the report using the milestones' information reported or an estimate of the probability of completing the associated milestones. This forecast is calculated using a linear regression model. This functionality is part of the initiatives related to the ABC strategy on Big Data.

4.3 Implementation control

During this step, the appropriate qualitative and quantitative control to the IT strategy implementation is performed.

The SPIDER information can be used to analyze the schedule and planning performance (i.e. critical path) based on interdependences and communication needs. During this activity, useful resources like "what-if" and sensitive analysis can be performed out. The status of the ITSI, domains and value streams is reviewed. It is important to mention this because the user can use the SPIDER output to "drill down" the anomalous situations and has the opportunity to find out where the cause of any warning signal is and the details of the EPM element that produced it. This activity supports the business by helping to identify and describe critical risks, assumptions, operational interdependencies, planning inconsistencies, coordination needs and risks. It provides meaningful, forward-looking information tied to the delivery of IT strategy.

The SPIDER is reviewed during the established steering committees. This activity provides regular updates to senior executives so that they can readily understand the progress and any urgent problem. This activity not only ensures that the IT strategy is built around the right things, but that it can also support senior executives in being effective in their leadership role during the implementation effort. This activity contributes to the senior engagement, allowing them to consider decisions and actions that will have biggest and quickest impact.

5. Results

The SPIDER was conceived as a tactical solution to manage the knowledge needed to monitor and communicate the implementation of an IT innovation strategy. However, once it was developed and its potential benefits seen, ABC senior management requested to explore the possibility of extending its use to other SBUs across the organization. This approach is the most effective according to Cosner *et al.* (2007). Once the mentioned sponsorship was obtained, several presentations were given to senior and middle

managers to share the knowledge gained and to communicate whether the tactical solution could become a strategic solution in the medium term.

The specific results obtained from the definition and use of SPIDER framework in the considered case study were analyzed from two different points of view:

1. assessment of SPIDER framework effectiveness; and
2. identification of the main factors that contribute to the effective implementation of SPIDER framework

The information for the results analysis was obtained during 15 meetings with the key personnel participating in the case study. During these meetings, qualitative information was registered in the meeting acts and quantitative evidence was obtained through the surveys distributed at the end of the assessment sessions.

5.1 Assessment of SPIDER framework effectiveness

The assessment of SPIDER framework effectiveness was done using the framework proposed by Bartenschlager (2011) already discussed in Section 2.

Table V contains the results obtained for each question included in the survey (Table IV) presenting the average values and the standard deviation. The survey items were measured based on multi-scale values and the Likert scale of 1 (total dis-agreement) to 5 (total agreement).

In general terms, the effectiveness of the SPIDER framework was evaluated positively because it represented an improvement in the comparison of previous ways for monitoring the implementation of an IT innovation strategy. As participants indicated (31 per cent of respondents), strategy implementation planning and communication were deficient, issues that were addressed through the SPIDER framework implementation. In this sense, the knowledge on the advance degree and problems generated during the implementation of the strategy was shared more effectively with the C-Suite instead of remaining with the people in charge of each individual development project.

Even more, 54 per cent of the respondents considered that the positive evaluation of SPIDER framework was due to its capability to provide an integrated view of the evolution of the strategy implementation. Participants considered that project managers have several tools that allow them to manage projects independently, but, in some cases, these tools

Table V SPIDER effectiveness

Question	*n* *Stat.*	*Range* *Stat.*	*Media* *Stat.*	*SE*	*SD* *Stat.*
How do you consider the currently planned and communicated technological plans within the organization?	26	2	2.85	0.132	0.675
What is your assessment of the processes and tools currently available to manage plans?	26	3	2.42	0.177	0.902
Do you think it is logical to communicate a plan through the use of a TRM?	26	3	3.77	0.150	0.765
Do you consider that the TRM would be effective to plan and communicate technological plans?	26	2	4.12	0.115	0.588
Do you consider that the TRM would be efficient to plan and communicate technological plans?	26	3	3.92	0.146	0.744
What is your assessment regarding the ease of communicating a plan by using the TRM technique?	26	3	3.88	0.178	0.909
Do you consider that the TRM is a flexible technique?	26	3	3.65	0.166	0.846
Do you think you could plan the implementation of a technological plan using the TRM technique?	26	4	3.58	0.185	0.945
Do you think there might be any organizational resistance in the implementation of TRM?	26	3	3.69	0.190	0.970
Do you consider that the TRM technique is a more effective medium to communicate than the existing PMO reports?	26	3	3.58	0.194	0.987

behave as independent silos difficult to use for obtaining a general and integrated view on the overall degree of a strategy implementation.

With respect to the assessment of the SPIDER framework features and its components, according to Bartenschlager (2011), a feature comparison allows one to understand how the ICT deals with the problems identified. Table VI shows the percentage of responses (4 and 5) by feature for the evaluation questionnaire.

Therefore, the SPIDER framework was considered logical and provides the necessary guidelines to support the implementation process; its visualization was very intuitive and it is easy to understand the meaning of its components. SPIDER was also considered efficient because it allows to report in a comprehensive way and with an executive view. On the other hand, SPIDER allowed reducing the elaboration time and the complexity associated with reporting the implementation of technical projects. SPIDER was considered flexible because it is possible to adapt it to the specific needs of the IT strategy, independently whether a large or small number of technical projects are involved. SPIDER achieves the planning feature through its capacity to structure, organize and standardize the implementation of an IT strategy. Clear responsibilities are formalized within the implementation process; SPIDER provides the strategic context within which an IT strategy can be developed with more confidence.

With respect to the challenges to managing the knowledge needed to monitor and communicate the implementation of an IT innovation in an ICT organization that handles massive information, as was mentioned at the beginning, ABC carried out a considerable number of projects. These projects have generated their own data related to planning, risk, milestones, etc. Most of this information is captured in big historical EPM databases. Within this Big Data collection lie valuable patterns and useful information that can be mined using some artificial intelligence techniques to support knowledge management.

Finally, there is a shift from looking at historical data to seeing how to use data to improve the organization. This shift will provide some benefits such as:

- insight from this vast amount of data;
- improvement in the quality of decision-making; and
- mitigation of the risk of complex decisions.

Once the right data are ready to be "consumed", SPIDER can be integrated with technology forecasting techniques and decision modeling (Gerdsri *et al.*, 2009), specifically predicting the expected delivery date of a milestone, the degree of risk or probability of timely delivery of an IT strategy based on the complexity and resources involved.

5.2 Factors that influence in the SPIDER framework implementation

Once the results of SPIDER framework are presented, this section presents the factors that influence in the effective implementation of this framework for monitoring and reporting the current state of a strategy implementation. Thee factors are relevant because they are oriented to facilitate the adoption of Big Data-based frameworks for monitoring the implementation of an IT innovation strategy.

To identify and discuss these factors, the correlation among the SPIDER effectiveness attributes was analyzed. Table VII represents a correlation matrix of the survey questions, and it determines the dependence between each question. It is important to mention that

Table VI Percentage of responses (4 and 5) by feature

Logical (%)	*Effective (%)*	*Efficient (%)*	*Ease of use (%)*	*Flexible (%)*	*Planning (%)*	*Communication (%)*
66	88	77	77	65	62	62

Table VII Correlations among SPIDER effectiveness attributes

		Correlaciones									
		Currently planned and communicated IT strategy	*Processes and tools currently available?*	*Logic*	*Effective*	*Efficient*	*Ease of use*	*Flexible*	*Implementation planning*	*Organization resistance*	*Communication*
Currently planned and communicated IT Strategy	Pearson Correlation	1	0.111	−0.149	0.046	0.055	0.035	0.323	0.333	−0.014	−0.042
Processes and tools currently available?	Pearson Correlation	0.111	1	−0.259	−0.020	0.170	0.062	0.147	0.218	−0.028	−0.105
Logic	Pearson Correlation	−0.149	−0.259	1	0.239	0.108	0.133	0.119	0.136	−0.369	−0.294
Effective	Pearson Correlation	0.046	−0.020	0.239	1	0.569**	0.624**	0.083	0.163	−0.286	−0.257
Efficient	Pearson Correlation	0.055	0.170	0.108	0.569**	1	0.223	0.274	0.520**	−0.366	−0.318
Ease of Use	Pearson Correlation	0.035	0.062	0.133	0.624**	0.223	1	0.310	0.174	−0.133	−0.101
Flexible	Pearson Correlation	0.323	0.147	0.119	0.083	0.274	0.310	1	0.860**	−0.379	−0.326
Implementation Planning	Pearson Correlation	0.333	0.218	0.136	0.163	0.520**	0.174	0.860**	1	−0.409*	−0.371
Organization Resistance	Pearson Correlation	−0.014	−0.028	−0.369	−0.286	−0.366	−0.133	−0.379	−0.409*	1	0.945**
Communication	Pearson Correlation	−0.042	−0.105	−0.294	−0.257	−0.318	−0.101	−0.326	−0.371	0.945**	1

Notes: **The correlation is significant at the level of 0.01 (two-tailed); *The correlation is significant at the level 0.05 (two-tailed)

each question was intentionally related to a component feature. The showed value is the Pearson correlation, which measures the linear dependence between two variables, and a *p*-value greater than 0.5 means that variables are correlated.

This analysis led us to identify the following factors that enable SPIDER effective implementation.

5.2.1 Effort required to elaborate the monitoring and reporting activities. There is a strong correlation (Sig(p) = 0.569) between the efficiency (77 per cent) and effectiveness (76 per cent) features of SPIDER. This correlation implies that the benefits provided by the SPIDER framework are related to the implementation of effective mechanisms to acquire information from the EPM systems used in the scope of each development project in the implementation program. It is also necessary for the definition of automated map/reduce routines to organize the data from the projects in a meaningful way for the IT innovation strategy managers. In this sense, the effective implementation of the SPIDER approach needs to be based in the provision of automated procedures to reduce the elaboration period and complexity required for each report.

5.2.2 Easiness to understand the reported information. There is a strong correlation (Sig(p) = 0.624) between the efficient (77 per cent) and ease of use (76 per cent) feature of SPIDER. This correlation implies that an effective SPIDER implementation relies on the provision of graphic mechanisms to show the aggregated information regarding implementation programs' value streams and critical milestones. Even more, the provision of tools to drill-down the events preventing the achievement of a goal or milestone is essential to provide the required support for decision-making in these circumstances. In this way, the SPIDER approach would decrease the time needed to understand and report the status of the IT strategy because its presentation is intuitive and easy to understand and can be obtained within a short period of time. The process of understanding involves developing models to emphasize meaning, and develop shared mental models amongst managers.

5.2.3 Detailed planning of the implementation program. There is a strong correlation (Sig(p) = 0.860) between the flexibility (65 per cent) and planning (55 per cent) feature of SPIDER. This correlation implies that the effective implementation of the SPIDER approach depends on the provision of a detailed plan for the program to implement the IT innovation strategy, including value streams definition and critical milestones identification. Even more, case study participants identified that the SPIDER framework application contributes to improve the planning of an IT innovation strategy. Its constant adaptation to the changes because the TRM is based on a parameters configuration that can mutate until it clearly represents user needs. The planning of an IT innovation strategy is a process where a shared understanding is translated into a coordinated action. The continuous monitoring and re-planning activities may improve the knowledge between participants and lead to institutionalization at the organizational level of the learned routines, rules and procedures, as well as the organizational "code".

5.2.4 Focus on communication efficiency. There is a strong correlation (Sig(p) = 0.520) between the valuation of the proposed technique for planning and its efficiency. This correlation implies that SPIDER would improve the planning and efficiency of communication because it would allow to generate a roadmap within a short period of time, helping to reduce the elaboration time and increasing the knowledge base capabilities through the planning reviews and/or assurance/feedback cycles.

5.2.5 Organizational resistance. Based on the results obtained during the assessment of the case study, 73 per cent of participants considered that the SPIDER framework implementation at the organizational level could have a relevant resistance. This issue was identified due to two different reasons:

1. The initial perception when SPIDER framework was introduced is related to the workload increase in management tasks for the strategy and project managers. This

initial negative impression changed at the end of the case study (the average effectiveness question is 3.92) but it is a barrier to consider for further adoptions.

2. In several cases, the SPIDER was seen as another project "fashionable" or "nice-to-have" deliverable required by C-Suite but not a useful tool for project management. This could be due to the lack strategic perspective of several managers of development projects.

6. Discussion

Several research works have identified the barriers to implement effective monitoring and communication in the implementation of IT innovation strategies (Hrebiniak, 2006; Alamsjah, 2011). As stated previously, these barriers to strategy implementation identified by Hrebiniak (2006), Alamsjah (2011) include:

- *Poor or vague strategy*: One of the most relevant barriers is undetailed definition of programs implementing IT innovation strategies without enough information on value streams, their related projects, critical milestones and dependencies among development projects. This research work agrees on the importance of providing detailed plans for IT strategies implementation programs. As the results obtained indicate, the SPIDER approach contributes to address this barrier allowing IT strategy to be planned in a detailed and visible way. SPIDER avoids the separation of planning and doing (Hrebiniak, 2006), by integrating technology into the business strategy (Gerdsri *et al.*, 2009). The roadmap allows performing several analyses such as the critical path plan, high-level dependencies, project tracking and deviations from the estimated dates regarding dates committee.
- *Poor collaboration or inadequate information sharing or knowledge reusing capabilities*: SPIDER supports knowledge management and influences the performance of organizations (Andreeva and Kianto, 2012), the IT strategy status and its planning (Phaal *et al.*, 2003a, 2003b) allowing senior managers to be able to make course correction when needed (Cabrey and Haughey, 2014).
- *Lack of knowledge (guidelines, models, etc.) available to support the implementation, monitoring and communication processes related to the IT innovation strategy*: The implementation of the SPIDER framework contributes to improve organizational learning practices related to the implementation of IT innovation strategy implementation. As Crossan *et al.* (2011), Jenkin (2013) state, the required practices to implement OLMs should be implemented at three levels: individual, group and organization. Table VIII summarizes how the SPIDER framework contributes toward solving the organizational learning problems related to the implementation management of IT innovation strategies. The SPIDER framework also contributes to document the best practices and the guidelines to increase the exploitation and exploration knowledge capabilities (Bennet and Tomblin, 2006; Taminiau *et al.*, 2010)
- *Weak or inadequate communication within organization* (Bartenschlager and Goeken, 2010; Bartenschlager, 2011). Bartenschlager and Goeken (2010); Bartenschlager (2011): The TRM standardizes the report of an IT strategy and allows to reach a consensus as a credible output (Lee *et al.*, 2012) and reinforce its active use. The SPIDER framework can be used as an effective coordination mechanism and control because it promotes the effective collaboration among stakeholders to provide the information at any organizational level in accordance to Soto-Acosta *et al.* (2014a, 2015).
- *Great difficulty to elaborate and communicate relevant information to stakeholders* (Hrebiniak, 2006): The SPIDER framework allows detailing the level of responsibility at each level. In accordance with Gerdsri *et al.* (2009), the implementation needs to be carefully planned, especially aligning the right people (key players) to guarantee the success.

Table VIII Characteristics of the organizational learning model implemented through the use of the SPIDER framework

Organizational level	*Learning process*	*Problems related knowledge management during the monitoring of IT innovation programs*	*Improvements obtained due to the implementation of SPIDER framework*
Individual	Intuiting	No access to historical information, experienced managers control/possess/have the pattern recognition	Explicit knowledge generated from the implementation of IT strategy can be accessed through the use of Web 2.0 elements (like wikis, etc.) Institutionalize the collection of lesson learned Promote the interaction around the implementation of IT strategies
	Interpreting	The shared understanding of the IT innovation strategy is poorly documented; there are no procedures or methods to determine the current state of an IT strategy implementation There is an isolation of teams that elaborate or use technology roadmaps to manage the implementation of IT strategy. No repository access	Development of procedural knowledge for SPIDER components (guidelines and procedures) to establish and formalize the process of elaborating and understanding of technology roadmaps Determine the criteria for identifying the status of milestones and implementation plan Standardize the work breakdown structures (WBS) of projects
Group	Integrating	TRMs may not include the agreement of diverse stakeholders TRMs are elaborated manually, almost manually Most of the planning milestones may not be related to the technical planning. This may affect the credibility or the achievement of the implementation of the IT strategy	The SPIDER report is the result of a shared understanding among the individuals that lead and collaborate in the implementation of an IT Strategy. A clear strategy is not sufficient. Such a strategy needs to be communicated to middle managers The SPIDER framework implements a process, subject to a configuration version and hardly connected to the technical planning, meaning that every milestone is linked to at least one milestone belonging to the development portfolio The implementation status report is based on the information reported in EPMs' databases
Organization	Institutionalizing	The format and length of TRM is not standardized or agreed on.	The SPIDER is a mandatory tool to manage the implementation of an IT innovation strategy due to its credibility, ease of use and understanding The SPIDER report is used at every review meeting as working document

- *Unclear responsibilities and accountability* (Hrebiniak, 2006): To address this issue, in the SPIDER framework, clear responsibilities are formalized within the implementation process, according to Phaal *et al.* (2003a), SPIDER provides the strategic context within which IT strategy can be developed with more confidence. SPIDER is considered a communication tool (Albright, 2009) because it allows the relevant stakeholders (in one slide) to have a top-down perspective of the implementation, as well as the chance to focus on clearly defined or achievable milestones, and to answer questions regarding global implementation status, risks, grade of advance, coherent interdependencies, quality across the projects and coordination actions.

7. Conclusions

This paper proposes a framework called SPIDER to effectively implement OLMs based on Big Data management principles for monitoring and reporting current status of IT innovation strategies. The value of SPIDER relies on its ability to summarize visually the IT strategy implementation plan by focusing on the work streams and a limited set of business and technical milestones.

The SPIDER framework was defined and implemented in the scope of a case study carried out in the context of defining and implementing an IT innovation strategies in the area of products related to life and casualty insurance for a large Spanish banking company by

> **"This research work focuses on applying organizational learning models (OLMs) and ICT tools to manage the knowledge related to monitoring and communicating an IT innovation strategy."**

ABC. At this organization, SPIDER was generated using the information pertaining to the EPM tool and resulted in an output graphical representation of the IT implementation plan.

The main features of SPIDER include:

- mechanisms to acquire massive information of the current status of a large amount of development projects carried out in the organization to implement the IT innovation strategy;
- mechanisms for automated organization to provide a consolidated and a drill-down view;
- relevant information regarding the current status of implementation to the C-Suite in a graphical way using the program implementation schedule as basis for the representation; and
- added value information for decision-making regarding probabilities of goals achievement in a period and risk prediction.

In general, the effectiveness of SPIDER framework was evaluated positively because it represented an improvement in comparison to previous ways for monitoring the implementation of an IT innovation strategy. The SPIDER framework contribute to address several problems related to:

- poor or vague strategy definition;
- poor collaboration or inadequate information sharing or knowledge reusing;
- lack of knowledge (guidelines, models, etc.) available to support the implementation process; and
- weak or inadequate communication within an organization.

During this research work, several factors that are essential to effectively implement OLMs based on Big Data management principles form monitoring IT innovation strategies were identified. These factors include:

- effort required to elaborate the monitoring and reporting activities;
- easiness to understand the reported information;
- detailed planning of the implementation program; and
- focus on communication efficiency.

The current version of the SPIDER framework is being improved through the development of machine learning techniques to determine value-added metrics related to the IT strategy implementation by using the historical information. Additionally, some Web 2.0 elements are being developed (Soto-Acosta *et al.* 2014b; Palacios-Marqués *et al.*, 2015), including wikis and internal blogging.

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Further reading

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