Framework for continuous agile technology roadmap updating

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Abstract

Purpose – Roadmapping has been used as an approach to support market, product and technology-integrated planning, resulting in a document commonly known as a roadmap. Despite the gains made in relation to the technique, recent studies indicate that most users leave or have difficulties in sustaining the process (i.e. maintaining the updated roadmaps). This paper aims to present a framework for continuous roadmap updating that incorporates principles from agile management fields.

Design/methodology/approach – The framework was developed through action research in a manufacturing firm in the construction industry.

Findings – The results demonstrate a positive impact on the degree of continuous information monitoring, roadmap credibility and use of the roadmap during innovation strategy decisions.

Originality/value – The key contribution of this framework is the demonstration of a new strategy for carrying out the maps in which information is internalized by the organization itself, using agile teams, without commissioned specialists and as part of the work standards.

Keywords Agile, Innovation planning, Project management

Paper type Research paper

1. Introduction

Roadmapping has been extensively applied over the past years, successfully supporting the formulation of integrated strategies and plans for technology and innovation (Phaal *et al.*, 2010). An important factor in its growth trajectory has been the development of methodologies capable of introducing the roadmapping process to companies by using simple, visual and value-oriented approaches (Phaal *et al.*, 2001a, 2001b, 2001c). Because of this, many companies have opened their doors to roadmapping.

After the initial period in which roadmapping was commonly introduced as a stand-alone application, further support became necessary to enable its continuous development and maintenance within companies (Garcia and Bray, 1997; Phaal *et al.*, 2010). However, most existing methodologies describing roadmapping processes lack information in this sense (Holmes and Ferril, 2006).

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The challenge is how to combine processes and people who are capable of inserting roadmapping as a continuous and living process, interconnected with the organizational routine or common usage business process. If this is not done, roadmapping will remain a stand-alone process, searching for its place after the first application and lacking opportunities to achieve continuous improvements of its results (Gerdsri *et al.*, 2009).

This paper presents a method to support the continuity of the roadmapping process in organizations, developed through action research in an innovative company. It supplements traditional processes focused on the introduction of roadmapping by adding a new roadmapping phase that implements a set of practices to integrate the roadmap with the regular and operational tasks usually performed in the enterprise. This method also considers competitive intelligence and agile project management techniques to update and coordinate people's involvement. Thus, it allows for continuous improvement of roadmapping results, interconnected with the decisions regarding innovation made in the strategic planning process, leading to a new level of organizational commitment toward roadmapping performance.

2. Technology roadmap updating

According to Phaal *et al.* (2001c), technology roadmapping (TRM) is an approach designed to support the planning and management of technology and is capable of taking advantage of technological directions and foreseeing future demands in uncertain environments (Lee *et al.*, 2011). The objective of this integration is to align different visions to respond to three key questions:

Q1. Where are we now?

Q2. Where do we want to get to?

Q3. How can we get there? (Oliveira *et al.*, 2012)

By February 2010, more than 170 studies about the process, structure, tools and benefits of TRM had been published (Vatananan and Gerdsri, 2010). In the first published studies, the authors were concerned with presenting different types of roadmaps, as much from the point of view of the application as from the visual forms of representation (Phaal *et al.*, 2001c). Later, efforts were concentrated on methods and instruction manuals for a fast-start approach, which gave rise to a fast-start manual, published by the Centre for Technology Management at Cambridge (Phaal *et al.*, 2001a). The most recent studies deal mainly with the implementation of the strategy approach and factors that influence its acceptance and use by companies (Lee *et al.*, 2011).

The problem with the updating of roadmaps has been addressed by the literature since it arose. Garcia and Bray (1997) note that the roadmap and its plans should be revised and updated frequently. A study of 2,000 British companies indicated that only 10 per cent of the companies (the majority of which were large) that had used the TRM approach continued to use the technique (Phaal *et al.*, 2001b).

Although the TRM approach has been considered a success in several companies (e.g. Motorola, Lucent Technologies, Philips and ABB), its maintenance has been a challenge (Phaal *et al.*, 2001a, 2001b, 2001c). The survey also identified that keeping the TRM process "alive" on an ongoing basis was the biggest challenge cited (50 per cent) and developing a robust process (20 per cent), which is connected with this problem, was in third place.

This continued throughout the 2000s when studies returned to the problem. According to Holmes and Ferril (2006), the literature on the problem of keeping roadmaps updated is scarce. The latest research indicating possible paths investigated the process of

roadmapping as part of the existing processes in an organization (Brown and O'Hare, 2001; Wells *et al.*, 2004; Phaal *et al.*, 2010), the application of the process of roadmapping (Gerdsri and Assakul, 2007) and the understanding of critical issues involved in the implementation process (Lee *et al.*, 2011). None of these articles, however, mentions changes in the procedures of roadmapping as a means to solve the problem (Brown and O'Hare, 2001; Wells *et al.*, 2004; Phaal *et al.*, 2010).

The integration of TRM with other business processes, so that its execution is no longer sporadic, is the most common solution mentioned. For example, Gerdsri *et al.* (2009) propose dynamic roadmapping for deployment, Phaal *et al.* (2010) highlight the need for integration of roadmapping with operational business processes and Caetano and Amaral (2011) advocate integrating roadmapping with open innovation.

Research by Holmes and Ferril (2006) shows that many of the organizations studied had review sections a few times a year, involving people from the tactical level. In these sections, the management team compared the development of the roadmap with what was planned. It was not proven to be an operational process, institutionalized in the company, but rather an indication of what is possible. Vatananan and Gerdsri (2010) note that it is necessary to monitor the status of the roadmap and take appropriate action before the roadmap becomes outdated.

It is concluded, therefore, that a possible solution is to develop a process capable of updating the roadmap and creating a feedback loop of the lessons learned for future formal updates, as suggested by Holmes and Ferril (2006). This would be a procedure performed by the company's own staff, as part of their routine work. Agile management techniques could help with practices that provide flexibility for continuous updating.

3. The principle of agility

One of the first definitions of the term "agility", as a concept, was observed in the area of manufacturing, disseminated as "agile manufacturing". According to Nagel and Dove (1991), a company with agile manufacturing would be capable of delivering new products quickly, assimilating market experiences and technological innovation easily and continuously and modifying its products to incorporate such experiences and new technology in its development processes.

In the area of project management, the term "agile management" became known from the development of a set of methods developed specifically for the area of software, such as Scrum (Schwaber and Beedle, 2001), Adaptive Software Development (Highsmith, 2000) and Extreme Programming (Beck, 1999). These methods were named "agile" or "lightweight methods", and their creators got together and prepared a manifesto, which was called the Manifesto for Agile Software Development. Since then, several studies have been conducted on the topic of "agility", and these methods have become known under the general acronym for agile project management (APM).

Amaral *et al.* (2011) define APM as an approach based on a set of principles whose purpose is to make the management process more simple, flexible and iterative to obtain better results in performance (cost, time and quality), less effort in management and higher levels of innovation and added value for the customer. Additionally, Conforto *et al.* (2014) provide evidence that the principles of agile management can be applied in different kinds of business. According to the authors, agility is the ability of the project team to change the project plan quickly and continuously in response to emerging customer needs, market demands and trends or opportunities to add value and deliver better results in an environment of innovative and dynamic business.

With this definition, it is clear that the "ability to change" is associated with the "project team", which can be extrapolated as the team involved in the management of the project or process with which they are dealing. This team should be able to change the original plan quickly and continuously, aiming to add value and deliver better results in an environment of innovative and dynamic business.

4. Research method

Action research was adopted for the development of the framework because this type of research aims to solve practical problems and contribute to science (Coughlan and Coghlan, 2002). The research team was composed of three researchers and professionals from the company identified in the text as EP.

The EP has been in the market for products in the area of civil construction for 73 years and is recognized for innovation and technology in the country. The organization is Brazilian and operates in the segment of consumer goods for civil construction. The organization has somewhere between 5,000 and 10,000 employees in ten countries. It has a wide range of products (more than 15,000), including different process technologies and different types of polymers. Recently, the company opted to create an integrated strategy and established a group of people to generate an innovation strategy. TRM was the method chosen to carry out the undertaking. The document analysis indicated that the first roadmapping workshop was held, generating 600 ideas for products and technology, 20 per cent of which remained in the final roadmap.

The selection of the company was intentional. As it is a research-type intervention, it was necessary to find a company that had experience in the adoption of the technique and that faced the problem of roadmap updating. In addition, an opening was necessary to conduct the action research process. The chosen company met the requirements, and it was an organization that had experience in developing new products and technology.

The first step for the team was to collect data of the roadmapping process from EP. For this reason, a document analysis was conducted, and the first collection instrument was applied; it consisted of 13 questions that guided the interviews with professionals of the company. Managers in the areas of R&D, marketing and engineering were selected, as well as specialists in products and technology, for a total of 12 interviews. Each of the interviews lasted approximately 1.5 h, totaling about 18 h.

Next, there was a diagnosis of the roadmapping process, and some gaps were identified with respect to updating the roadmap. Based on the identified gaps and the difficulties of the company, there was a specific literature review of monitoring information and agility.

5. Description of the framework

The framework proposal, agile roadmap management, presented in Figure 1, consists of three steps:

(1) plan the cycle of updating;

(2) manage the cycle of updating; and

(3) analyze the strategy of innovation.

These steps consist of a set of activities with a specific focus. The first step consists of sequential activities that involve knowledge of operational processes and organizational culture. The second step comprises a continuous cycle of activities in which energy is spent to keep alive the updated roadmap and roadmapping. Finally, in the third step, the result of the upgrading effort, the analysis of the organization's innovation strategy, is used. The

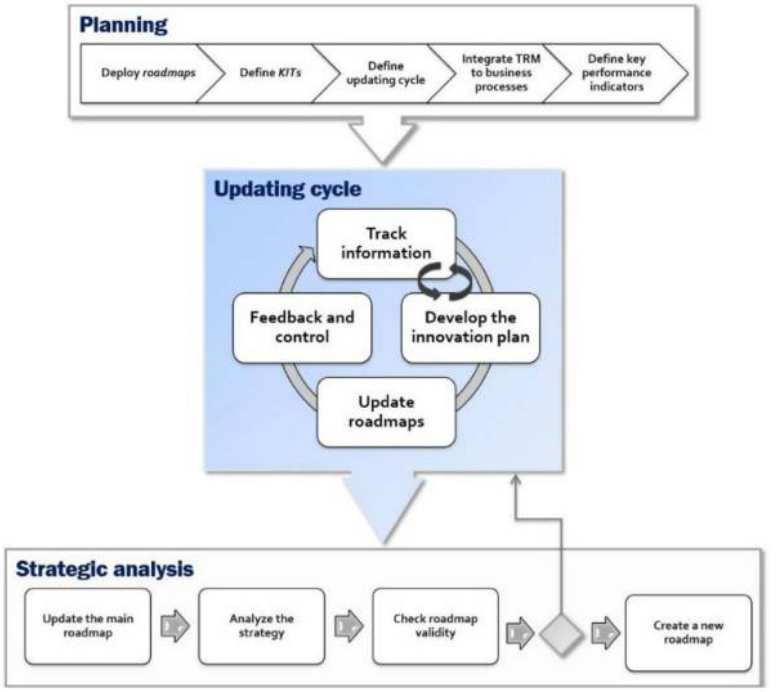

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Figure 1.
Framework for updating roadmaps

diamond shape identifies a decision point at which the organization assesses the validity of the current roadmap and chooses to continue with the upgrade cycle or create a new roadmap, depending on the validity of the current roadmap in the face of the changing competitive environment.

5.1 Requirements and conditions for application of the framework

The framework was developed for updating roadmaps of the technology product type, as classified by Kappel (2001). From the organizational diagnosis, it was possible to define some requirements for its use to be effective:

- The existence of the first roadmap must be assumed.
- The existence of a person or team to manage the process is presumed, as proposed by Holmes and Ferril (2006). The experience gained during action research shows that this team must devote at least 20 per cent of their working time to the process. It appears that a longer time than that could compromise other processes in the company.
- It must be ensured that the update cycle (Phase II) occurs in iterative cycles, a feature that can provide agility to the process.
- It should be flexible (i.e. allow progressive advancement so that the team adds activities as the organization receives information that impacts the plan).

- It should prescribe that the steps in the proposed framework serve as a reference, and it needs to be adapted, preferably by experts in TRM, according to the company's needs (i.e. the framework is a guide for professional use in specialized deployments).

5.2 Stage 1: planning the updating cycle

The first stage of the framework aims to transform the creation of the roadmap into something tangible for its application. For this reason, this stage was divided into five activities, as shown in Figure 2. At the end of this step, the organization will have determined certain parameters necessary for the management of the upgrade cycle.

5.2.1 Deploying roadmaps. A roadmap is a document that expresses the innovation strategy of the organization for the future. Therefore, it is expected that a document containing this type of information is of utmost confidentiality. It was soon found that it would not be possible to share the whole map with each of the functional areas. The need for information security mechanisms to prevent confidential information from exceeding the limits of the company was identified. This was a new challenge, not mentioned in the literature, which had to be faced by the action research team.

The solution was to develop a method of deployment such that the strategy was deployed to each of the functional areas of the company in a way that ensured discussions at lower levels were restricted to the technology of the domain of the employees and that the most strategic decisions were made from the synthesis of the discussions of the functional areas. According to this concept, coined by the action research team, the strategy is deployed to each functional area, which created a specific "mini roadmap" based on niche markets, product families and technology used both in a product and in its manufacturing. In the company in question, there were business units and within them areas of the technological domain, which resulted in 14 "functional" roadmaps.

The main roadmap was formed by the roadmapping management team, which in the case of this company was the action research team. They consolidated the roadmaps of the areas in a central map, along with senior management and invited experts. The general map contains proposals at a macro level, such as "technology × platform", "development of the market for the niche y" and "new product line with a focus on sustainability".

The challenge of the roadmapping process management team is, together with the functional areas, to deploy the topics in a way that represents the relationships of the area with its surrounding environment. At this point, the involvement of managers belonging to the tactical level of the organization is important, as managers, in general, are responsible

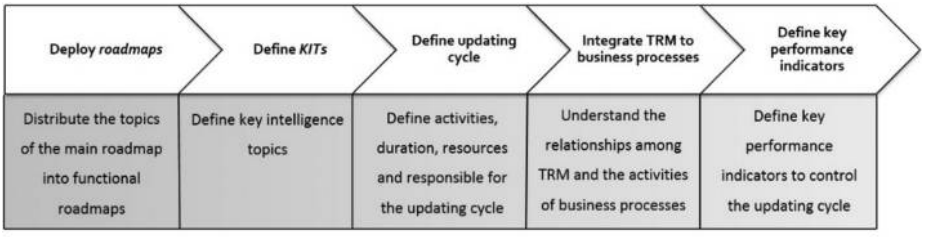

Figure 2.
Flow of activities of the planning stage

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for building the connection between the organization's strategy and the operational activities necessary to transform it into reality.

Each topic present in the roadmap, whether it is in the layer of the market, products, technology or resources, has a context within the competitive environment. It does not consider a product that is not related to a need of the market or technology or which does not promote significant improvements in the products and manufacturing processes. Thus, the deployment of the main roadmap allows each functional area to receive its goals and visualize the relationship that exists between the goals and other elements of the competitive environment.

Figure 3 shows two examples of roadmaps deployed. It can be seen that the layered structure was maintained, and a parallel idea of the meaning of each layer in the context of the functional area was carried out. For example, in the roadmap of raw materials, the focus of the "market" is related to trends in raw materials and product lines that require developments in raw materials. The layer of products represents the exits or delivery areas, such as the development of a new metal or polymer. The technology layer contains the knowledge of how to process the raw materials, and, finally, the resource layer contains the means that support development.

5.2.2 Define KITs. From the deployed roadmaps, each functional area identifies a range of topics, such as market trends, products, technologies and partners to be monitored. Furthermore, each area in its day-to-day life finds a series of key issues where there is a need for greater knowledge. Thus, it is necessary to establish key topics of intelligence so that the search for information is efficient. The way to ensure this process is by using and disseminating around the company the concept of KIT. An understanding of which topics

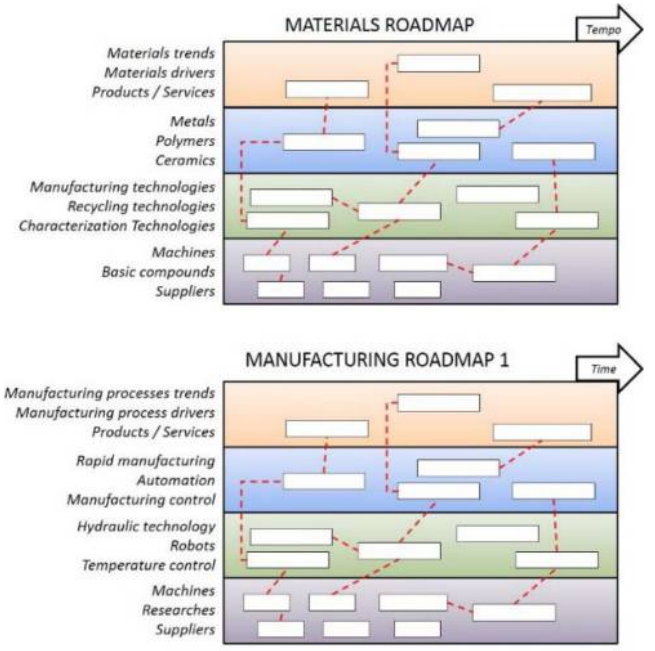

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Figure 3.
Example of roadmaps deployed

are strategic and give value to the organization is essential for this process. This planning work can save time and effort for the teams that are, in this case, restricted given the goal of not exceeding 30 per cent of the total time with other activities.

5.2.3 Define updating cycle. The updating cycle, Stage II of the proposed framework, is the operational process of the updating roadmaps model. The first iteration of the agile management was chosen. The concept of iteration consists of dividing the total project time into equal parts and repeating a small cycle of planning to develop and evaluate each of these parts.

The action research team adapted this concept to roadmapping. Thus, the total time between the normal updates of roadmapping, which is a review of the strategic planning of the organization, was divided into equal parts, each one called a "cycle." In each cycle, the teams must deliver updates on their functional maps and at the end of the cycle integrate the results.

Figure 4 exemplifies this process. Using as a basis a company that holds an annual event to revise its strategic planning, there are two options: evaluate the upgrade cycle before the plan review or divide this evaluation into small cycles. In the second case, one option would be to divide the evaluation into cycles of 60 days; then, during every iteration, the roadmapping management team could analyze the status of developments, check the progress of the teams, review critical issues and identify areas for the improvement of the updating cycle.

From the iterative cycles, which contain the monitoring of information, there is enough knowledge to provide the board feedback and, if necessary, take measures with the plan of innovation (e.g. modify the route initially established, invest and seek forms of partnership). The course of action will depend on the competitive environment of the organization, average time of project development, rate of change of the environment, degree of risk tolerance and culture of the organization for decision-making.

5.2.4 Interconnect operational processes with iterative cycles. Some operational processes feed the roadmap with information, and others receive information from the roadmap to happen. Figure 5 shows one way of understanding this relationship through a metaphor. Imagine a window that consists of two parts. The roadmap would be the landscape as seen from the window, which displays the innovation strategy of the company. The first part is composed of processes, methods and tools, whose main purpose is to generate information

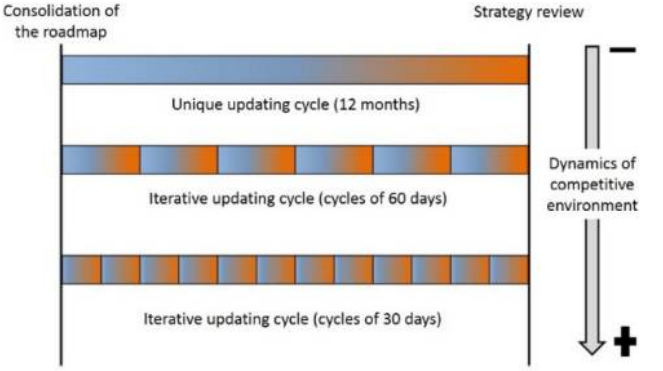

Figure 4.
Planning of the updating cycle because of the dynamics of the competitive environment

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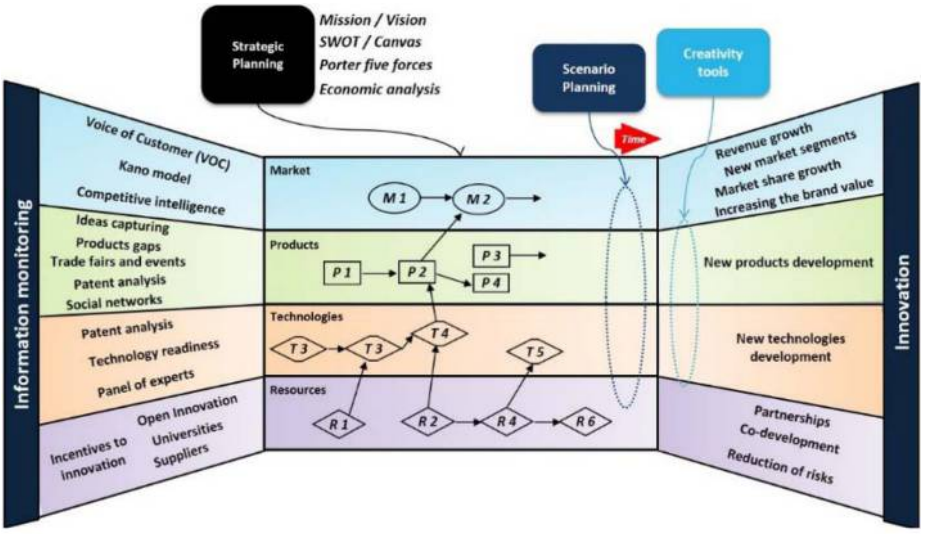

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Figure 5.
Integration of roadmapping with operational processes, methods and tools

about quality, while the second tab is formed by processes that transform information and plans into reality. That is how the action research team presented the proposed procedure to the employees.

The integration was stimulated by the inclusion of the trigger concept. Operational processes were reviewed and mapped using the management view. Points of interfaces, called "triggers" were identified. This modeling allows all staff involved to understand specific points of their operational processes that can generate actions for the roadmapping process (i.e. triggers for the roadmap). This is a way of preparing them to respond to these situations by looking for, dealing with or updating information. The manuals for the integrated management of organizations and meetings with stakeholders of the process roadmapping are useful tools in identifying the relationships between processes.

For example, it is possible to imagine a roadmap that contains the theme "sustainable product development" and a catchment area for ideas, whose function is to capture ideas for new products or technologies for new development. During the operational process, this area has identified two patents of new products that use recycled raw materials. With the knowledge that this process is the trigger for the roadmap, the manager must include this information in the table of the area roadmap. If it is interesting, the management team can share information with other specific areas of the company or even add it to the main roadmap.

5.2.5 Define performance indicators. It is necessary to establish control parameters associated with performance indicators so that the updating cycle can be controlled and evaluated. What is critical to the process (CTPs) and what is critical to quality (CTQs) can be evaluated. In the first case, an analysis of the role of the process in question in the context of business is sought, while in the second case, the results of the process are evaluated from the perspective of the customer.

One should take into consideration that the process of roadmapping and the updating cycle is composed of several subprocesses. Thus, the management team must define the

level of control that will be applied. The control of subprocesses and/or control of the upgrade cycle as a whole can be applied. The experience acquired with action research showed that one way to accomplish the definition of performance indicators is to understand the objectives, expected results and customers of the process. Thus, a combination of indicators that evaluate both CTPs and CTQs was adequate.

5.3 Stage 2: manage updating cycle

Stage 2 is a cycle of monitoring, control and feedback activities with the goal of managing the activities related to the updating of roadmaps.

5.3.1 Monitoring information. The information monitoring flow can be divided into three stages. The flow consists of three activities with specific goals: collect data, analyze it and disseminate information or intelligence to the organization. During the execution of these activities, a number of methods and tools can be implemented.

The flow needs to emphasize the shared responsibility of monitoring information, which in the case of agile is expressed by the concept of self-management. The application of this procedure means explicitly decentralizing the activities of collecting and processing data in roadmapping. In traditional models, these tasks are performed by specific functions of the company or by organizations contracted especially for the task. The procedure developed requires the participation of all stakeholders in the roadmapping process. This decision was made considering with the assumption that no functional area has all the knowledge necessary to identify and analyze all information of the competitive environment.

The starting point for monitoring information is knowledge of the key topics. Based on these topics, various areas of the company can "adjust the tracking radar." Another important point is to use the results of other operational processes of the company that result in information identified in Phase I as triggers.

The focus of the teams boils down to interpreting the collected data and transforming it into information. One piece of information can be understood as data interpreted from the perspective of the competitive environment of the organization. Analyzing the information and the roadmap deployed enables evaluation of how the information relates to the strategy, which results in intelligence. It is this intelligence that must be disseminated throughout the organization.

A viable alternative for cases in which teams are located in the same building or sector is the table for monitoring information. This tool was implemented during the action research and proved to be effective. The process is based on the characteristics of agile, which are "use of visual artifacts to control" and "frequency of interaction between managers and staff." Figure 6 illustrates the process of monitoring.

The flow of the table for monitoring information first begins with the collection and analysis of data. The employee accesses data sources seeking topics defined previously and then interprets and shares information on a mural, which is set in a place where many people pass by. Second, a resource of the updating process of the management team monitors and registers the new information in a database. This activity is carried out for two reasons: to keep a record of monitoring and to use information in meetings with functional areas.

Third, members of the functional teams visualize the panel and become aware of the information. If the information indicates threats or opportunities for the company, the employee proposes the critical issue to be analyzed. Likewise, the resource of the management team registers the critical issue and forwards it to the related managers in the end. In turn, the manager analyzes the question and responds to the proponent.

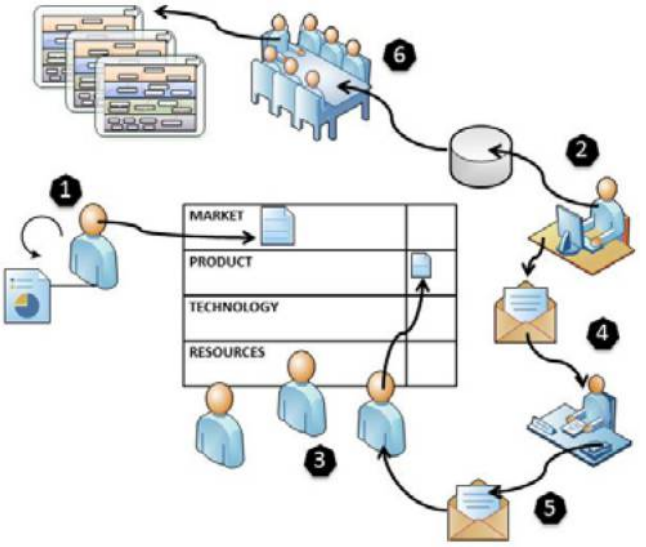

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Figure 6.
Flow of the table for monitoring information

In the second stage, the process management team meets together with the functional areas, and together, they access the database information. This activity relates to the activity "updating roadmaps." Thus, from the information and critical issues addressed, the functional roadmaps are updated. This tool promotes self-management of the employees in relation to the monitoring of information. Moreover, it is a tool that promotes information sharing and knowledge management. The shared information feeds not only the updating process of roadmaps but also other operational processes of the company.

5.3.2 Monitoring the innovation plan. The second activity of the updating cycle involves monitoring the development of the innovation plan, which, as mentioned previously, is formed by the roadmap and development plans. This activity takes place alongside the activity of monitoring information. The purpose of this activity is to carry out the monitoring and synthesis of roadmaps in each area of the company.

The innovation plan consists of a series of necessities, such as new products and technologies, market analysis, new partnerships and the search for resources (human and financial). The plan becomes reality based on development processes, such as new product design projects, technologies, and manufacturing processes. Generally, each process uses resources from various areas of the company, but they are managed by specific areas. Therefore, it is necessary that the roadmaps updating management team visit those responsible for the processes and identify the status of each item planned in the innovation plan (roadmap).

5.3.3 Updating roadmaps; feedback and control. The activity of updating roadmaps starts with a meeting with one or more representatives of the innovation management team and the team responsible for the functional roadmap. The meeting agenda consists of discussion of the following points:

- the status of development of the innovation plan;
- critical issues, such as threats, opportunities and difficulties;

- the risks involved (increased, diminished, does not exist anymore, etc.) based on the monitoring of information and developments;
- the validity of the current roadmap, from the monitored information; and
- the performance indicators.

From this filter, critical issues of lesser impact that generate "triggers" for alterations in roadmaps and issues of greater critical impact whose actions should depend on approval by senior management can be identified. Thus, necessary action plans for critical issues of lower impact are defined, and alteration in the order of planned developments is approved. This time is essential for the management of the upgrading process because the analysis carried out is the source of communication to stakeholders of the roadmapping process and is the movement of the chain needed to promote the development of the innovation plan. These activities enable the integration of the roadmap with the organization's strategy, as proposed by Oliveira *et al.* (2012).

5.4 Stage 3: analyze innovation strategy

Having performed the updating cycle for deployed roadmaps, the roadmapping management team has collected enough information to update the main roadmap and analyze it from the perspective of the organization's strategy. Stage 3 of the framework concludes with two decisions by senior management: carry out action plans to address critical issues, understanding that the current roadmap is still valid, or create a completely new map.

5.4.1 Update the main roadmap. The status of deployed roadmaps is the starting point for updating the main roadmap. With this information, the focus of the management team should be on the strategic roadmapping routes (SRs) defined at the time of the consolidation of the roadmap, as shown in Figure 7.

The SRs are composed of a chain of elements of market, product, technology and resources, which generally represent the link between the organization's strategic planning and innovation plan. Therefore, assessing the status of SR means assessing the impact of the status of the innovation plan on the organization's strategy.

This activity is carried out on the basis of evaluation of the development of the elements of the chain, observed in feedback and control meetings with the functional

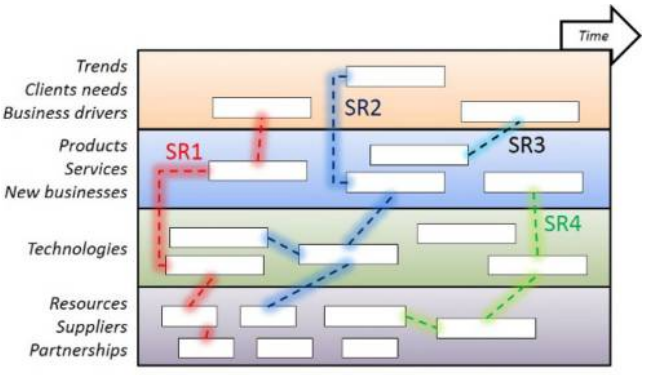

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Figure 7.
Strategic routes

areas, and the information collected during the monitoring of information. The result of this activity is a document, in the form of a management report containing an assessment of all SRs, divided into two subsections: status of development and competitive environment analysis.

The second section contains a collection of information that makes up the intelligence about the competitive environment of the organization. This document is sent to senior management at the end of the update cycle and can be considered to be the main delivery of the update of the roadmaps framework.

5.4.2 Strategy analysis; verify the validity of current roadmap. The activity of analyzing the strategy is the responsibility of the senior management of the organization. At this time, the roadmapping management team can be invited to participate, primarily to help with possible doubts about the management report. Strategy analysis is a complex activity that relies on some information beyond the managerial report on roadmapping, which is therefore outside the scope of the update framework.

The main output of this activity for the process of roadmapping is the guidance on actions related to strategic routes, the solution of critical issues and the decision on the validity of the current roadmap. Because of the information about the competitive environment, a change of strategy and, consequently, alteration of the SRs present in the roadmap may be required. On the other hand, one can conclude that the roadmap is no longer valid in the current environment, thus implying the need for consolidation of a new map.

The roadmapping management team should be advised of these strategic decisions so that they take the necessary actions. The first path involves adjusting the SRs of the main roadmap, communicating with stakeholders about the roadmapping process and continuing with the updating cycle. The second path, in turn, comprises planning and preparation for building a new roadmap.

6. Supporting the roadmap updating

The literature is rich with strategies for deploying roadmapping in organizations, as well as templates for a quick start. This focus on the start of roadmapping can be explained by the need to instantly achieve results and demonstrate the advantages of their application. However, as the organization is the first version of the roadmap, the cost and effort involved discourage the continuation of the process.

The proposed framework did not use traditional methods to control the upgrading process, to ensure flexibility and speed while absorbing the changes in the competitive environment. Therefore, it is believed that the framework proposed uses flexible concepts to manage the process. However, in the current stage of development, it is not possible to say that the framework is agile. To support such a claim, the application of the framework in different competitive environments and the analysis of metrics of agility would be necessary, which is beyond the scope of this study. Another doubt that arises is how the proposed framework differs from existing frameworks. Until now, the research on roadmapping has not addressed the problem of updating roadmaps in an alternative manner, as in the present study. The literature pointed to possible paths, such as roadmapping integration of the operational processes and the need for management of the process after the construction of the first roadmap. However, none of the research presented an effective solution to the problem. Refer to Holmes and Ferril (2006) and Gerdsri *et al.* (2009).

The framework proposed by Holmes and Ferril (2006), called the operation and technology roadmapping, aimed to help small and medium enterprises in Singapore in the

identification and selection of emerging technologies. The framework involves an initial review of technologies, products, services and drivers to check how "accurate" the predictions previously made were and establish rules for the creation of the next roadmap. Then, the decision to only upgrade the current roadmap or build a completely new roadmap is made.

Neither the integration of roadmapping with other operational processes is discussed nor is the monitoring of information. It can be considered that the major contribution of the study of Holmes and Ferril (2006) is in the analysis of the need to only update the map or proceed to build a new roadmap.

The research of Gerdsri *et al.* (2009) presented a discussion of the need for organizations to understand how the new activities and responsibilities of those involved in the roadmapping process relate to the dynamics of the implementation of the deployment process. Using the implementation strategy divided into three phases as a starting point (initiation, development and integration), the authors make general recommendations regarding how roadmapping can be integrated into the operational processes of the organization.

The study of Gerdsri *et al.* (2009) presents two major contributions to the literature:

(1) A framework that identifies the role and responsibilities of the main stakeholders of the roadmapping process.

(2) A flow of activities for the steps of initiation and development in the roadmapping process. However, the study does not show evidence of how the integration step can be performed.

The proposed framework contributes to theory in four respects:

(1) It merges the gaps in theory with the practical experience of the problem of updating roadmaps.

(2) It presents a framework that contains operational activities and management activities.

(3) It proposes a possible solution that addresses the three fundamental problems for updating roadmaps (integration with operational processes, monitoring of information and development of the innovation plan).

(4) It uses the concepts of agility in the management of the model.

7. Conclusion

The proposed roadmap updating framework recommends the creation of specific procedures for updating a roadmap. As discussed, there is no literature on a specific script for this purpose, and the results indicate that the framework is viable because it was applied in a real case, benefitting those involved. Besides being feasible, the proposed framework differs from the methods proposed by Holmes and Ferril (2006) and Gerdsri *et al.* (2009) in one main respect: the framework presents practices that represent effective solutions for the integration of the roadmapping process with other processes of the organization (the deployment of roadmaps, the updating in cycles, the competitive intelligence distributed and the mapping and use of triggers).

The proposed steps (planning, updating cycle and strategic analysis) can be continuously optimized with the introduction of new methods, tools and activities that will bring the organization closer to excellence in using the roadmap for the promotion of innovation. The use of concepts of agility, such as iterative planning, use of visual artifacts to monitor the process and frequency of interaction between team and manager, can be

considered a response to the challenge posed by Muller (2003), who recommended phasing in several short stages, where the benefits are immediately presented without saying how to execute it.

The framework and these practices constitute real evidence that it is possible to create specific procedures for updating technology. This is a conclusion with a significant impact on the theory. It opens a possibility that can be explored further by researchers. The implication is that perhaps two types of theoretical models of TRM are required. One type focuses on creating maps of the breakthrough type (i.e. new maps for companies that do not have technology planning or for situations in which there are maps, but disruptive changes in the market or technology demand a new and complete reorientation). The other type, another set of TRM procedures, focuses on the updating and continuous improvement of existing maps, in short cycles, as proposed in this paper, and it can be used continuously in the interval between two breakthrough updates.

It is necessary for the framework to be implemented in different organizations and in different competitive environments and for new tests to be performed. The company mentioned in this paper can serve as the next validation if it is simply observed in the near future to see whether the process has been sustained and benefits are being realized.

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Further reading

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