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# An activity guideline for technology roadmapping implementation

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To strive for sustainability under today's intense business competition, organisations apply technology roadmapping (TRM) as a strategic planning tool to align their technology strategies with business strategies. Many organisations desire to integrate TRM into an ongoing strategic planning process. The consequences of TRM implementation can lead to some changes in the business process, organisational structure, or even working culture. Applying a change management approach will help organisations to understand the basic elements that an individual needs so that some challenges can be addressed in advance before adopting the TRM process. This paper proposes a practical guideline to implement technology roadmapping along with a case example.

**Keywords:** technology roadmapping; TRM; TRM implementation; change management; activity guideline

## 1. Introduction

As global competition continues to intensify, organisations find that it is necessary to maintain the focus on their core competencies. Technology roadmapping is viewed by practitioners in the field as an innovative strategic planning tool to visualise and formulate the linkage between a business and technology strategy (Groenveld 1997; Kostoff and Schaller 2001; Kappel 2001; Phaal and Muller 2007). McMillan (2003) state that the integration between business and technology strategies can be a complex task and the results may lead to some changes in the organisational structure and culture. The results from the industry survey conducted by Institute of Manufacturing, University of Cambridge in 2000 indicate that most organizations experiencing TRM implementation consider the TRM process as an integrative process (Phaal, Farrukh, and Probert 2001). The survey was sent to 2,000 technical directors of UK manufacturing firms. Furthermore, the survey results indicate that about 10% of the responding organizations have made use of TRM. Respondents among these companies consider three challenges of roadmapping: keeping the roadmapping process 'alive' on an ongoing basis (50%), starting up the TRM process (30%), and developing a robust TRM process (20%).

Technology roadmapping is a process-oriented approach which often requires cross-functional participation (Cosner et al. 2007). Thus, the process depends on people and an individual

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contribution throughout the process is considered as one of the key success factors along with process and data (Gerd Sri and Assakul 2007). Cosner et al. (2007) state that the transition to a roadmap-based planning process is a major cultural change for organisations and it should be addressed appropriately by using change management techniques. Generally, organisational changes can be defined through an observation of variations in shape, quality or state over time, after the deliberate introduction of new ways of thinking, acting and operating (Pardo del Val and Fuentes 2003; Schalk, Campbell, and Freese 1998). TRM scholars suggest that the implementation of TRM may require staff to obtain new skill sets or an organisation to acquire new capabilities (Kostoff and Schaller 2001; Strauss and Radnor 2004). Therefore, applying a change management approach will help organisations set up a supportive change environment (Cosner et al. 2007) and a proper plan for TRM implementation. Applying a change management approach can assure that people involved in the roadmapping process are able to cope with new processes and procedures.

This paper proposes an activity guideline for TRM implementation by referring to the change management approaches of Prosci's ADKAR (Hiatt 2006) and Kotter's eight steps (Kotter 1996). The first approach is used to address the key elements of change that are required by a TRM implementation. The latter approach is used for setting up a step-by-step plan to lead people and organisations through changes across all stages of TRM implementation.

## 2. TRM implementation

A technology roadmap is a visual representation of the organisation's strategy (Kostoff and Schaller 2001; Phaal, Farrukh, and Probert 2001; Rinne and Gerd Sri 2003; Phaal and Muller 2007). In general, technology roadmapping is viewed as a strategic planning tool that allows organisations to link their technology strategies with their business strategies (Nauda and Hall 1991; Groenveld 1997; Wells et al. 2004). To successfully implement technology roadmapping, it is important to establish a clear objective and focus of a roadmap (Cosner et al. 2007; Garcia and Bray 1997). The TRM process and architecture also need to be customised to synchronise with an organisation's objective and culture (Fleury et al. 2006; Lee and Park 2005; Phaal, Farrukh, and Probert 2004). To maintain the TRM process on a continuous basis, it is vital to integrate the process into ongoing business and technology planning activities in an organisation (Daim and Oliver 2008; Garcia and Bray 1997; Groenveld 1997; Phaal et al. 2003). Gerd Sri, Vatananan and Dansamasatid (2009) propose viewing the implementation of TRM in three stages according to the different objectives in each stage as shown in Figure 1.

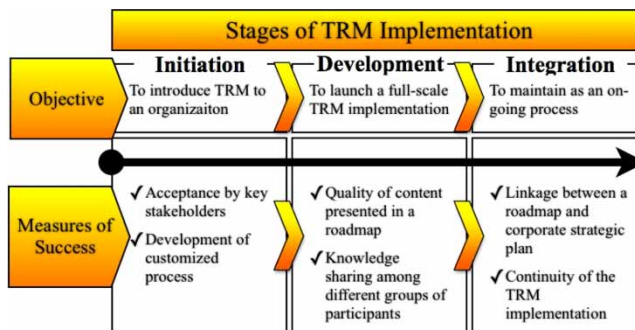


Figure 1. Different stages of TRM implementation.

### ***Initiation stage***

The purpose of this stage is to provide the opportunity for gathering and disseminating necessary information needed in later stages. In this stage, key players come together to form a core team – a group of people responsible for initiating the roadmapping process. In the initiation phase, it is important for individual key players as well as a team to prepare themselves by learning and understanding the TRM process. Throughout the initiation stage, members of a core team work together to customise the generic TRM concept. The purpose is to align the TRM process with an organisation's strategic planning process and working culture (Phaal, Farrukh, and Probert 2004). The success of this stage's activities can be measured through the acceptance of the TRM concept among key stakeholders and the development of a customised TRM process.

### ***Development stage***

The main emphasis in this stage is to collect and analyse data from internal and external sources. A series of TRM workshops are organised to analyse data and present the results in the graphical form of a roadmap. Several iterations of the roadmapping process may be required before resulting in the desired outcomes (Phaal and Muller 2009). During the workshop sessions, participants from different departments work together in generating and sharing their knowledge and expertise to develop a company roadmap (Phaal, Farrukh, and Probert 2000, 2005, 2007; Wells et al. 2004). The contributions from individuals and teams are necessary to assure the success of TRM development. The success of this stage's activities can be measured through the quality of the content presented in the roadmap, as well as the level of knowledge and experience shared among the different groups of participants.

### ***Integration stage***

The function of this stage is to integrate the TRM process into ongoing business operations, since the TRM initiative should not be considered as a one-off effort (Kostoff and Schaller 2001; Phaal, Farrukh, and Probert 2001). For a successful integration, the organisation should assign ownership of the TRM process to a group of people who are responsible for regularly maintaining and updating the roadmap. The success of this stage's activities can be measured through the quality of the alignment between the technology roadmaps and the corporate strategic plan, as well as the continuation of roadmapping on a day-to-day basis.

## **3. Change management**

An organisation is a web of interconnections; therefore, a change in one area will have an impact on others. A change management approach helps organisations to manage and guide their people through the TRM processes. Having the right people and a strategic alignment between TRM and strategic processes should lead to the desired results (Duck 1993). One crucial aspect in managing changes is to empower people (Jellison 2006). This is why the role of an idea champion, who provides energy and leadership to the change, is so important (Daft and Bradshaw 1980; McCall and Kaplan 1985; Howell and Higgins 1990; Gerdsri, Assakul, and Vatananan 2008).

In general, people do not like change. Resistance to change commonly comes from employees who have negative attitudes or counter-productive behaviours (Waddell and Sohal 1998). The responses of individuals toward changes originate from a variation of their status quo, lack of

trust and understanding behind a proposed change, fear of the unknown and uncertain future, different perception on the benefits gained from a change, as well as reservation of organisational culture valuing tradition and customary ways.

If change is not well managed, resistance will have a negative impact on the change effort and may increase its costs, delay its completion, or even endanger the survival of change. However, if change is properly managed, constructive resistance can be turned into a source of innovation (Waddell and Sohal 1998).

To effectively manage change, key players need to understand the elements of change and a step-by-step process leading the change. The next two sections review two well-known concepts of change management: Prosci's ADKAR Model and Kotter's eight steps of change.

### **3.1. Prosci's ADKAR model**

The ADKAR model focuses its attention on the five elements to prepare individuals for the change. Each element of change is described below (Hiatt 2006).

#### *Element 1: Awareness of the need for change*

To be able to change, the organisation and its members need to know and understand the rationales for changes. Awareness represents a person's understanding of the nature of the change including why the change is being made and the risk of not changing.

#### *Element 2: Desire to make the change happen*

To motivate people to change, the organisation needs to create positive or negative consequences influencing individual's desire for engaging in a change. Desire represents the willingness to support and engage in a change. Desire is ultimately about a personal choice influenced by the nature of the change as well as an individual's personal situation and intrinsic motivation.

#### *Element 3: Knowledge about how to change*

Motivation to change alone is not enough to initiate a change. Individuals need to understand what the proper behaviour looks like. They need examples and guidance so that they can obtain the knowledge of what the correct behaviour or procedure is.

#### *Element 4: Ability to implement new skills and behaviours*

Once the required knowledge is obtained, basic practices need to be provided to attain the abilities and skills necessary for engaging in a change. Ability can only be achieved when a person or group has the demonstrated capability to implement the change at the required performance levels.

#### *Element 5: Reinforcement to retain the change*

To anchor the new behaviour in the corporate culture, individuals need some reinforcement to keep the good behaviour going. Reinforcement consists of both internal and external factors. External reinforcements could include recognition, rewards and celebrations that are tied to the realisation of the change. Internal reinforcements could be a person's internal satisfaction with his or her achievement or other benefits derived from the change on a personal level.

### 3.2. Kotter's eight steps of change

Kotter (1995) introduces the eight-step process to manage change. The eight-step process is a direct response to the top eight, most common errors organisations and management make when confronted with change (Kotter 1996). A brief definition of each step is provided below (Cohen 2005).

#### *Step 1: Establishing a sense of urgency*

The prime objective of this step is to raise awareness of the need and importance for making changes. If it is done correctly, creating an atmosphere of urgency will reduce complacency and gain needed cooperation. It will generate interest and motivate people to take action.

#### *Step 2: Creating a guiding coalition*

A synergistic effect among members can be enhanced by providing some assistance to a team in areas like communication and knowledge sharing. A guiding coalition helps to facilitate the decision-making process and provides access to better information so that a team is able to act more quickly.

#### *Step 3: Developing a vision and strategy*

To be successful, the change effort needs a compelling and motivating picture of the future. A vision helps to coordinate actions and to identify behaviours that should be encouraged or eliminated.

#### *Step 4: Communicating a change vision for buy-in*

Communication of the vision is essential to develop understanding for the necessity of the change effort and to convince people to buy-in. This helps to gain access to needed resources and captures the commitment of the workforce. By sharing a desired future, it creates motivation and provides assistance to coordinate all participating members through the transformation.

#### *Step 5: Empowering employees to act on the vision*

To empower people to support and carry out change, obstacles must be removed. Each individual in an organisation should be enabled in order to take broad-based actions leading through the change.

#### *Step 6: Generate short-term wins*

These timely, visible and meaningful achievements are critical to build the credibility needed to sustain the change effort over time. They also provide a visible proof to stakeholders that the effort is paying off and thus helps to sustain motivation, moral and commitment of key players.

#### *Step 7: Consolidating gains and producing more change*

The momentum created by the short-term wins can be used to move the change effort forward and enable key players to take on bigger and deeper changes. However, it is essential for leaders to continue conveying their commitment to employees and management as well as to maintain the urgency and not to declare premature victory.

*Step 8: Anchoring new approaches in the culture*

In this step the new behaviours are woven into the organisational culture. In order to achieve a sustainable integration of the change, leaders need to adopt the new behaviours themselves as well as reward and recognise their subordinates for adopting them.

**4. Applying change management to guide TRM implementation**

As mentioned earlier, technology roadmapping is not just a process – people involved in the process are crucial to the success as well. Cosner et al. (2007) explains the importance of forming a cross-functional team by involving people from different departments in the process. For example, people from the marketing and new product development departments may assume more roles in developing a roadmap while people from operations and support departments might focus on aligning their resources and day-to-day activities with a roadmap. People participating in the TRM workshops are a main source of knowledge (McCarthy 2003). Brown and O’Hare (2001) emphasise that the success of a roadmap is linked to the quality of knowledge captured.

**4.1. Level of effort required over the three stages of TRM implementation**

Applying change management can assist an organisation to set up a proper TRM implementation plan and guide key players to cope with the new TRM process. A well-designed plan will reduce the resistance to change imposed by the TRM implementation. Figure 2 shows a conceptual illustration of the level of effort required over the three stages of TRM implementation. The level of effort is determined by focusing on the amount of effort needed to overcome challenges and resistance. The higher the level of resistance is, the greater is the effort required in managing activities throughout the implementation.

At the beginning of the initiation stage, the level of resistance rises quickly in a short period of time. This is because key stakeholders are skeptical about the value of TRM implementation as well as about their requirements for preparing to engage in the activities. Key stakeholders need more information to develop a clear understanding of the scope and direction in pursuing the TRM initiative.

As TRM implementation continues to the development stage, the level of resistance is likely to rise again. Some participating members may experience inadequate market or technology

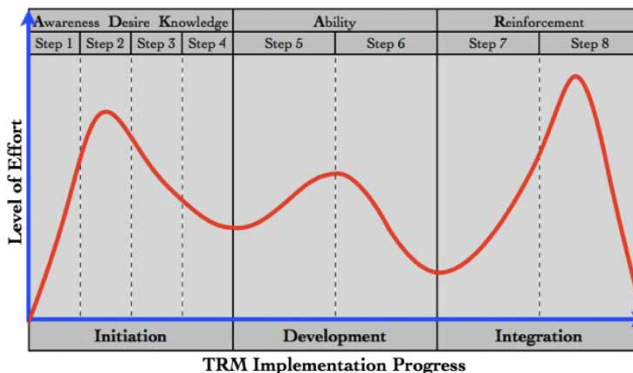


Figure 2. Conceptual illustration of the level of effort required through TRM.

information used for the roadmapping analysis, while there can be disagreement among members on any specific issue. Organisations have to take corrective actions to manage the process of roadmapping analysis, search for available information and facilitate group discussions. With the proper actions, the level of resistance can be managed.

Maintaining the TRM process as a part of ongoing business operations will cause the level of resistance to rise again at the beginning of the integration stage. In many organisations, this stage is where the highest level of resistance is reached. The reasons are not only because a larger number of people are now involved, but also because of the establishment of new and unfamiliar processes and procedures. People might be pushed out of their comfort zone as they are forced to change their behaviour and adopt new ways of conducting business.

#### **4.2. An activity guideline for TRM implementation**

The following section describes the use of ADKAR and Kotter's eight-step model of change management to aid TRM practitioners in understanding the basic elements needed in preparing individuals for change and the actions required to manage the TRM process through all three implementation stages. Table 1 presents examples of activities needed for facilitating and supporting the TRM implementation process. These activities are properly determined in correspondence to both the ADKAR and Kotter models.

As described earlier, the purpose of the initiation stage is to define the scope of the TRM initiative, select a team of key players and prepare them to be ready for TRM implementation. The three elements of the ADKAR model; awareness, desire and knowledge, are concentrated along with Kotter's first four steps to create a sense of urgency, form a guiding coalition, develop a change vision and communicate the change vision throughout the organisation.

In the development stage, the activities emphasise the interaction of key players and their synergistic effort in analysing data and information. The interaction among individual team members can lead to the creation of new knowledge that supports the development of a roadmap. The ability element of the ADKAR model is concentrated along with steps 5 and 6 of Kotter's model emphasising the empowerment of people involved in the process and the plan for achieving short-term wins.

In the integration stage, the main attention lies on how to seamlessly integrate the new TRM process into day-to-day operations of the organisation. The last element of the ADKAR model, reinforcement, is considered in conjunction with steps 7 and 8 of Kotter's model. The emphasis is on invigorating the new processes and behaviours in the organisation to anchor the TRM process as a part of normal business practice and to keep the roadmapping process alive.

It is important to remember that technology roadmapping needs to be customised for each organisation to fit with its organisational context. The action plan presented in Table 1 is general and can be applied to most situations.

## **5. A case example**

### **5.1. Background**

The company presented in this case example is one of the leading manufacturers in the ASEAN region. The company has multiple strategic business units (SBUs). Its products have been widely recognised for their high quality by customers, both in local and international markets. Several

Table 1. An activity guideline for technology roadmapping (TRM) implementation.

Change management concepts		Action plan to support the three-stage TRM implementation process	Stage of TRM implementation	Key success factors (KSFs)
Prosci's elements of change	Kotter's eight steps of change			
Awareness Desire Knowledge	Step 1: Create a sense of urgency	<ul style="list-style-type: none"> <li>✓ Understand the value of applying TRM in the organisation</li> <li>✓ Build awareness of why TRM implementation is needed</li> </ul>	Initiation	<ul style="list-style-type: none"> <li>✓ Acceptance of the initiative by key stakeholders</li> <li>✓ Development of a customised TRM process</li> </ul>
	Step 2: Form a guiding coalition	<ul style="list-style-type: none"> <li>✓ Discuss the details of TRM concept</li> <li>✓ Raise urgency of why TRM implementation is immediately necessary to all participating members</li> </ul>		
	Step 3: Develop vision and strategy	<ul style="list-style-type: none"> <li>✓ Develop a vision, objective, and scope of TRM implementation for the organisation</li> <li>✓ Set the plan to roll-out TRM implementation</li> <li>✓ Gain acceptance and sponsorship from top-management</li> </ul>		
	Step 4: Communicate vision and strategy	<ul style="list-style-type: none"> <li>✓ Communicate the vision for the buy-in and support from key players</li> <li>✓ Form a working group responsible for activities related to TRM implementation</li> <li>✓ Provide the fundamental concept of TRM to all participants</li> <li>✓ Prepare all participants to be ready to implement the TRM process. Training sessions may be provided.</li> <li>✓ Customise the generic TRM process to fit with the organisational setting</li> </ul>		
Ability	Step 5: Empower people	<ul style="list-style-type: none"> <li>✓ Plan and organise a series of workshop sessions to develop a roadmap</li> </ul>	Development	<ul style="list-style-type: none"> <li>✓ Content quality presented in the roadmap</li> </ul>

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Table 1. Continued.

Change management concepts		Action plan to support the three-stage TRM implementation process	Stage of TRM implementation	Key success factors (KSFs)
Prosci's elements of change	Kotter's eight steps of change			
	Step 6: Create short-term wins	<ul style="list-style-type: none"> <li>✓ Allocate responsibilities to each individual in the group as well as set up ground rules for the group participation</li> <li>✓ Maintain the momentum and energy from all participants throughout the TRM development process</li> <li>✓ Remove barriers blocking participants from carrying out their TRM activities</li> <li>✓ Conduct debriefing and review sessions</li> </ul>		<ul style="list-style-type: none"> <li>✓ Knowledge sharing among different groups of participants</li> </ul>
Reinforcement	Step 7: Consolidate gains	<ul style="list-style-type: none"> <li>✓ Consolidate roadmaps into one master roadmap (if needed)</li> <li>✓ Establish the procedures to review and revise a roadmap so that a roadmap can be kept alive</li> </ul>	Integration	<ul style="list-style-type: none"> <li>✓ Linkage between roadmap and corporate strategic plan</li> <li>✓ Continuation of technology roadmapping</li> </ul>
	Step 8: Anchor new approaches	<ul style="list-style-type: none"> <li>✓ Integrate TRM process into organisation's existing processes</li> <li>✓ Transfer ownership of the process to the proper group of people</li> </ul>		

market research activities have been initiated with a special emphasis on fulfilling requirements to the satisfaction of customers.

Recently, the company announced its new strategic vision to focus on 'creating a product solution for all' instead of providing separate components to the market. To complete this new vision, the company decided to reform itself from being a product manufacturer to a total solution provider. Therefore, the development plan for each product must be integrated into one system, in order to provide better product solutions for their customers in the future.

### 5.2. TRM implementation

The technology roadmap development project was carried out at the beginning of 2006 after three month of preparation. The company's ultimate objective was to have a corporate master roadmap representing the future direction of all major strategic business units (SBUs). Table 2 describes

Table 2. Applying a change management approach to organise activities supporting TRM implementation: A case example.

Action plan to support the TRM implementation process	A case example presenting how the subject company organised the activities to support its TRM implementation
<p><i>Initiation</i></p> <ul style="list-style-type: none"> <li>✓ Understand the value of applying TRM in the organisation</li> <li>✓ Build awareness of why TRM implementation is needed</li> <li>✓ Discuss the detailed concept and the roll-out plan of TRM implementation</li> <li>✓ Raise urgency of why TRM implementation is immediately necessary to all participating members</li> <li>✓ Develop a vision, objective, and scope of TRM implementation for the organisation</li> <li>✓ Gain acceptance and sponsorship from top-management</li> <li>✓ Communicate the vision for the buy-in and support from key players</li> <li>✓ Form a working group responsible for activities related to TRM implementation</li> <li>✓ Provide the fundamental concept of TRM to all participants</li> <li>✓ Prepare all participants to be ready to implement the TRM process</li> <li>✓ Customise the generic TRM process to fit with the organisational setting</li> </ul>	<p>The ‘idea champion’ was identified. He was a person who saw the value of TRM and tried to bring it into the organisation. He took the initiative to acquire the basic knowledge about technology roadmapping. He communicated with the external people who had experience in technology roadmapping to discuss about the possibility of implementing TRM at the company. After all details of technology roadmapping were clarified, the company decided to develop a product-technology roadmap for each strategic business unit and then aimed to compile them at the end to represent a corporate master roadmap. The external TRM research/consulting team was officially brought in. The research/consulting team began to work with the internal team to setup the plan for facilitating the TRM implementation process. The joint team also discussed the link between the proposed roadmapping activities and other existing strategic/business planning in the company.</p> <p>To effectively roll out the activities and build up a quick buy-in from key stakeholders, the joint team decided to execute TRM implementation in multiple phases instead of rolling it out to all SBUs at the same time. Since it was the first time that TRM was introduced to the company, setting the pilot execution allowed the joint team to fully focus on the needs of the pioneering SBUs. As a result, the resistance from key stakeholders in adopting the new process was minimised and a quick win could be declared. The success in the pioneering SBUs helped to reinforce the buy-in from the remaining SBUs.</p> <p>As part of building a vision and strategy for the TRM initiative, the idea champion and research/consulting team worked together to communicate with key stakeholders to rally for their buy-in and support. Due to the novelty of the TRM initiative at the company, the idea champion had to communicate with top management regarding the balance of the expectations between a learning process and the quality of the roadmap content. A kick-off meeting for TRM implementation was organised. The President of the company was invited to inform his staffs about the needs and expected benefits from the TRM implementation.</p>
<p><i>Development</i></p> <ul style="list-style-type: none"> <li>✓ Plan and organise a series of workshop sessions to develop a roadmap</li> <li>✓ Allocate responsibilities to each individual in the group as well as set up ground rules for the group participation</li> <li>✓ Maintain the momentum and energy from all participants throughout the TRM development process</li> </ul>	<p>After identifying pioneering SBUs, the TRM operation teams were formed for each SBUs. The team leader was appointed to be a project manager of each SBU team. The operation team of 6–8 members was assembled from key staffs involved in strategic planning, marketing, product development, engineering, and R&amp;D activities in each SBU.</p>

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Table 2. Continued.

Action plan to support the TRM implementation process	A case example presenting how the subject company organised the activities to support its TRM implementation
<ul style="list-style-type: none"> <li>✓ Remove barriers blocking each participant from carrying out the TRM activities</li> <li>✓ Conduct debriefing and review sessions</li> </ul>	<p>The research/consulting team customised the TRM process to match with the types of information available. In case that the needed information was not available, the research/consulting team gave advices to the TRM operation teams to temporarily substitute that information with the team's judgement during the workshop sessions. However, the substituted information needs to be replaced later on with complete information. This approach helps to keep the momentum of the teams alive to continue through the TRM process without any interruption. A step-by-step workbook with examples was also distributed as part of the workshops. The facilitator and members of the research team helped in creating a dynamic atmosphere during the workshop sessions, to allow all members of the working team to challenge each other on related issues.</p>
<i>Integration</i>	
<ul style="list-style-type: none"> <li>✓ Consolidate roadmaps into one master roadmap (if needed)</li> <li>✓ Establish the procedures to review and revise a roadmap so that a roadmap can be kept alive</li> <li>✓ Integrate TRM process into organisation's existing processes</li> <li>✓ Transfer ownership of the process to the proper group of people</li> </ul>	<p>After completing the development stage, the ownership of the TRM process was transferred from the initial idea champion to two key stakeholders in the company. One is a business planning manager, who is a process owner of business planning activities. The other one is a technology manager who manages a portfolio of technologies and leads a group of technological experts in the company. The transfer of ownership assured that the TRM process would be adopted as a part of the company's ongoing process by seamlessly integrating it into the existing business planning process. Some redundant activities between roadmapping and business strategic planning were removed so that the whole analysis process was smoothly integrated. The periodical review and update of roadmaps were scheduled by linking the timing with the development of strategic plan organised in Q3 and the development of action plan organised in Q4.</p>

how the subject company organised and exercised its activities to support TRM implementation along the three stages by following the activity guideline as presented in Table 1.

### 5.3. Lessons learned from the case example

The implementation of technology roadmapping allowed the company to focus on its strategic continuity by linking the development of technologies to business. Without TRM, it would have been challenging for the company managing different SBUs to collaboratively work together and develop a shared-product strategy.

Based on our direct experiences and involvement in the company's TRM implementation, we have observed that:

- Identifying the 'right idea champion' is crucial because this person is a key individual to communicate with top management and rally for buy-in from key stakeholders. A great deal of leadership is required from this person.

- Securing management commitment is a high priority. This can be presented by several activities such as arranging a company-wide meeting to kick-off the TRM initiative, setting up a special meeting to review the results after completing major milestones in the TRM development process, etc. Strong enthusiasm and support from management helps to maintain and drive the momentum of the working teams.
- Conducting an initial assessment before planning the TRM implementation for each SBU is necessary, since the TRM process and approach have to be customised to match the specific level of readiness of each SBU.
- Creating an environment supporting open communication is important, so that information is shared freely among different groups of participants and the content is verified before it is analysed.
- Identifying a proper process owner is also necessary to keep the TRM process alive. As technology roadmapping becomes part of the ongoing business planning process, preparing the seamless integration into existing planning processes is crucial. A roadmap needs to be periodically reviewed and updated, where the timing has to be synchronised with other business planning activities.

## 6. Conclusion

The proposed guideline could be used as a checklist for an individual or team who is responsible for deploying the roadmapping process. The guideline was developed by applying the approach of change management and addressing them through the three stages of TRM implementation: initiation, development and integration. The case example included in this paper elaborates on how the subject organisation made use of the proposed guidelines to set up its TRM implementation plan.

By following the proposed guidelines, TRM practitioners can prepare participating members to be ready to cope with new processes and procedures. The step-by-step action plan can lead key players and stakeholders through the changes required for TRM implementation. Moreover, from our direct engagement through the implementation of technology roadmapping at the subject organisation, we have learned that having a 'right idea champion' to lead the team with full support from top management and a clear TRM process customisation helps to minimise resistance to change from participating members and business units.

## Notes on contributors

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