



Dealing with the dynamics of technology roadmapping implementation: A case study

Nathasit Gerd Sri^{a,*}, Ronald S. Vatananan^a, Sasawat Dansamasatid^b

^a College of Management, Mahidol University, Bangkok 10400, Thailand

^b SCG Building Materials Co., Ltd., Siam Cement Group, Bangkok 10800, Thailand

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ABSTRACT

Nowadays, companies are facing many challenges. The product life cycle is getting shorter while the complexity and the demand for product customization are increasing. Technology Roadmapping (TRM) has been widely used as a strategic management tool to help organizations in effectively identifying potential products or services for the future, determining proper technology alternatives, and mapping them with resource allocation plans. With the completion of TRM implementation, any organization can be assured that its required technologies and infrastructures will be ready when needed. Implementing TRM as a part of the ongoing strategic/business planning process is challenging because it may affect the organizational work process, structure, and culture. Therefore, an organization needs to understand how the changing roles and responsibilities of key players involved in the TRM process match with the dynamics of TRM implementation in each stage. This paper illustrates the dynamics of TRM implementation and presents a case study to demonstrate how one of the leading building product manufacturers in the ASEAN region went through the process.

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1. Introduction

Under today's intense business competition around the world, companies are seeking for a sustainable way to gain their competitive advantage. The majority of businesses focus their attention on using business and marketing strategies to gain competitive advantage while the exploitation of technology strategies is still limited [1,2]. As a result, only one side of the business is taken into account for the strategy development, and the linkage between business and technology strategy is not strengthened. This is a reason why the concept of technology roadmapping (TRM) has been widely adopted by practitioners in the field to help integrating technology into business strategy [3–5]. Various TRM applications used in industry, government, and academia can be reviewed for an example [6–13]. The process of technology roadmapping and the subsequent integration of the roadmap into an ongoing business processes in any organization are considered as a complex change [14–16]. Researchers continue to develop additional tools to customize the roadmapping process by integrating it with technology forecasting techniques and decision modeling [17–21]. Critical factors to the successful implementation of a roadmap development are people, processes and data [3,15,17,22,23]. The dynamics of a technology roadmap implementation process may have a significant effect on the company's current business process. Therefore, the implementation needs to be carefully planned, especially in aligning right people and resources into the process to guarantee the success. By understanding the dynamics of TRM implementation, it is critical for individuals and team to adjust their roles and responsibilities accordingly.

First, this paper explains the dynamics of TRM implementation in different stages; initiation, development, and integration. Second, the paper addresses the significant roles and responsibilities of key players in creating and transferring the knowledge needed to develop an effective roadmap. Third, the paper elaborates how the roles and responsibilities need to be changed in order

* Corresponding author.

E-mail address: cmnathasit@mahidol.ac.th (N. Gerd Sri).

to match with the dynamics of TRM implementation. Lastly, a case example is presented to show how one of the leading building product manufacturers in the ASEAN region went through the implementation process.

2. TRM implementation process

The general approach for TRM implementation in an organization can be classified into three stages: initiation, development, and integration [24].

Stage 1: *Initiation stage* aims to get an organization ready before beginning to implement TRM process.

Stage 2: *Development stage* aims to develop a desired roadmap by engaging right people, gather the necessary information, and conduct a step-by-step analysis.

Stage 3: *Integration stage* aims to integrate TRM process into an ongoing business planning activities so that a roadmap can be constantly reviewed and updated in a timely manner.

For organizations that intend to develop a roadmap as a one-time effort for guiding their strategic vision, the TRM implementation effort can be stopped after the development stage is completed. However, some organizations, which want to assimilate the TRM process into their ongoing business operations, need to continue through the integration stage. The detailed explanation of main activities conducted in each stage and the key measures for success are described as follows and summarized in Fig. 1.

2.1. Initiation stage

It is important for any organization to start off with the right approach. The purpose of this stage is to provide the opportunity for gathering and disseminating necessary information to use in the later stages. In this stage, core teams are formed. The individuals as well as groups prepare themselves by understanding the basic knowledge, requirements, and approach of technology roadmapping. The ground rules for team participation need to be set as well.

After the official kick-off for the TRM initiative, basic information addressing the concept of technology roadmapping is distributed to key stakeholders, in order to convince them and get them to buy into the initiative. With increasing numbers of supporters and buy-ins, the first-cut technology roadmapping workshop can be organized. Throughout the initiation stage, the core teams should discuss about the customization of generic TRM concept to make it fit into the strategic planning process and the organization's working culture.

The success of activities in this stage can be measured through the acceptance of TRM concept among key stakeholders and the customization of TRM process to meet organizational needs.

2.2. Development stage

The main emphasis of this stage is on data collection and analysis. A series of TRM workshops is conducted to analyze collected data and graphically present the results in a roadmap form. The workshop participants are the members of the TRM operation team organized within each SBU. The collection of data can be done both internally and externally. The benefits gained from the workshops are not only to analyze data, but also, to share, transfer and create knowledge [25,26].

The success of activities in this stage can be measured through the quality of content presented in a roadmap and the level of knowledge and experience sharing among different groups of participants.

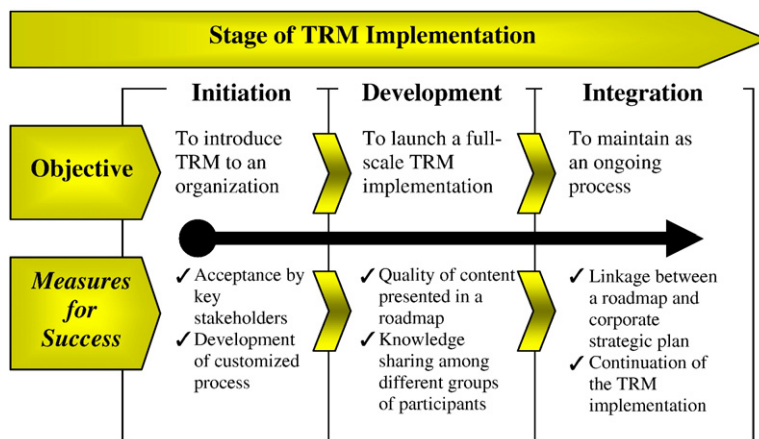


Fig. 1. Objective and measures for success in different stages of TRM implementation.

2.3. Integration stage

After the completion of the development stage, the focus of TRM implementation is moved to the integration of the roadmapping process into the ongoing business operations of the organization. This integration is vital, since the TRM initiative is not a one-time effort but rather it should be exercised as an ongoing process [17]. During the integration stage, the main roles and responsibilities are transferred to the idea champion team. The aim and desired result is the complete fusions of the TRM process into the organization, so that the roadmapping process becomes a part of strategic business planning. With the successful integration, a roadmap will be maintained and updated as part of normal business operations.

The success of activities in this stage can be measured through the strength of the linkage between technology roadmaps and a corporate strategic plan as well as the continuation of TRM implementation.

3. Key players

In general, the contributions from individuals and teams are necessary to assure the successful implementation of any initiative in an organization. This is also applicable for the TRM implementation. Key players involved in the TRM implementation come from different levels and sub-groups of the organization. The most important and influential players are idea champions, champion team, TRM operation team and support team. The engagement from an external consulting team may be necessary, especially in an organization that implements TRM for the first time. The involvement of the external consulting team may vary from one organization to another and the level of its engagement should be carefully assessed to assure that technology roadmaps can be developed and the TRM process can be integrated into the ongoing business operations. The following section describes the characteristics of each player and their interaction, which can be conceptually illustrated as shown in Fig. 2.

3.1. Idea champion

The *idea champion* is the one who provides the energy to move the subjects to gain acceptance for the change [27]. The emergence of the idea champion is an indispensable ingredient in the process of innovation and strategic change [28]. This individual sees not only the needs and benefits for innovation, but also provides transformational leadership throughout the implementation process [29]. This makes the idea champion important as an impetus to change and to overcome constraints. The champion's main role is to guide the members of the organization through the change process and mitigate constraints along the way.

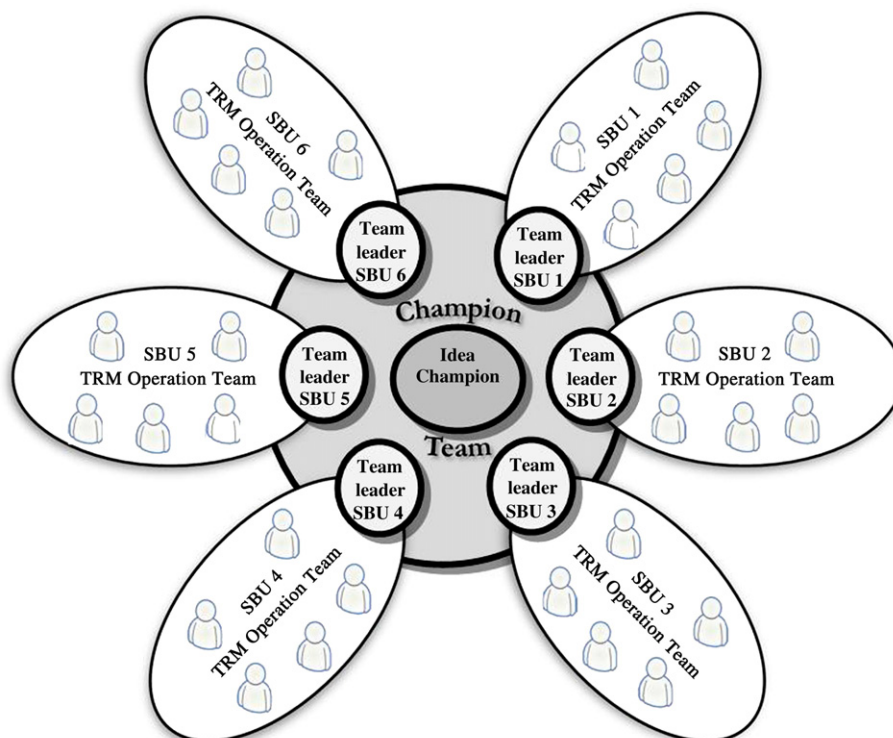


Fig. 2. Interaction among idea champion, champion team, SBU idea champion, and SBU operation team.

3.2. *Champion team*

The champion team is a group of idea champions in which each individual represents a different SBU. As compared to the characteristics of individual idea champions, the champion team makes use of its team dynamic, commitment, diversity, and flexibility in addition to their individual traits. The champion team is a driving force of the TRM initiative and is critical to its success [30]. Each member of the team will lead a group of participants from his/her SBU through the TRM development process. In addition to the roadmap development, the champion team is also responsible for finding a proper way to integrate the road-mapping process into the ongoing business processes of the organization.

3.3. *TRM operation team*

The TRM operation team is a working group assigned and handpicked by the idea champion of each SBU, to participate in the development of a SBU's technology roadmap. An idea champion who is also a member of the champion team leads the group. The members of the TRM operation team are recruited from major divisions (e.g. strategic planning, marketing, engineering, product development) of each SBU. Each individual has strong knowledge and experience in his/her functional area. With the combined knowledge from the team, the future trends and needs for the SBU can be determined and used as strategic inputs for the TRM development.

3.4. *TRM support team*

The TRM support team is formed and initiated by the idea champion as the administrative body of the TRM implementation. Even so, the role of this team will increase over the course of the implementation. Its main function is to capture, store and distribute resources and information. The support team will be the resource center of the TRM initiative.

4. **Involvement of key players in each stage**

All aforementioned key players are involved in all stages of implementation but the levels of their involvement differ from one stage to another. In each stage, the types of engagement can be scoped at individual, team as well as organizational level. Through all stages, knowledge is being created, shared and transferred as the driving part of the implementation process [25,31].

4.1. *Initiation stage*

During the initiation stage the focal roles of individuals and teams are to learn and to communicate. The main responsibility is to understand the complete process of technology roadmapping and the nature of the three implementation stages. The following section will discuss the roles and responsibilities of the key players in this stage.

The idea champion: Because the TRM process represents a considerable change to the organization, a single idea champion might not be able to cope with the amount of responsibilities. This is why the idea champion needs to communicate his/her knowledge and understanding of the initiative to other key stakeholders, in order to form a team of idea champions (also referred by Kotter as a guiding coalition) [30]. In this stage the champion's main responsibility is networking to bring the right people together [14]. To do this, his/her individual mastery on TRM implementation is essential in order to communicate and inform or even educate key stakeholders.

The champion team: The group of individual idea champions, assembled from several SBUs, forms the champion team. The team members are well respected experts who will lead their SBUs through the implementation process. This high performance team will be the driving force through the three stages of the TRM implementation. The formation of the idea champion team will ensure the effective diffusion of how important the TRM initiative is for the organization [30]. But to be effective communicators, the members of the team need to have the same level of understanding and knowledge about the initiative. Through individual learning and first-cut workshops, all members of the champion team will raise their level of understanding about Technology Roadmapping. The common and equal understanding among the team members creates a dynamic, which is needed for the collective learning and facilitation process [31,32]. In addition to their function as transformational leader and facilitator of the TRM development, the champion team will serve as a communication link between Top management and the TRM operations team [25].

TRM operation team: For the purpose of a roadmap development, the individual member of the champion team, who is a representative from each SBU, is responsible for setting up his/her own TRM Operation Team. Members of the team must be carefully chosen to represent an effective blend of expertise across several functional departments within the SBU (e.g. Marketing, Engineering, Product Development, R&D, Finance, etc.) [33]. At this stage, the activities of the TRM operation team are mainly to capture the basic knowledge and get themselves ready for participating in the development stage.

TRM support team: The TRM support team begins to form with the objective to operate as a resource center. The team's responsibility is to provide basic information related to their corporate business and TRM implementation collected from both internal and external sources. The team needs to create open-communication channels for all SBU's TRM operation teams to access that information.

4.2. Development stage

At this stage, the actual roadmap is being developed. The major activities are to extract, distribute and share knowledge through a series of workshops [14,26]. The following sections will discuss the roles and responsibilities of the key players in this stage.

The idea champion: At the beginning of the development stage, the idea champion assumes the role of a leading facilitator, responsible for the coordination of relevant knowledge sources and preparation of individuals for the roadmap development. The idea champion needs to create a relaxed and productive atmosphere for participants in order to smooth the progress of knowledge creation and transfer which will continuously incur during the TRM development process. The idea champion also conducts feedback sessions with internal and external participants to make appropriate adjustments [34]. Once the champion team is ready to carry the work, the idea champion will transfer the ownership to the team and then focus his/her roles on assisting the champion team as conflicts and problems arise.

The champion team: After the idea champion provides general guidance to the champion team, each member of the champion team starts to facilitate the TRM development process for his/her own SBU. Being a part of the champion team, each member is responsible to share feedbacks and lessons learned from the workshops with all members so that the team can strengthen their common knowledge and experiences. In addition, the individual member of the champion team in each SBU must play a role as a project manager in controlling the progress, motivating participants and negotiating for proper resources.

TRM operation team: In this stage, the TRM operation teams from all SBUs carry the main load in developing their unit's roadmap. The team members gather and analyze relevant information needed through the roadmap development process. The gained insights are captured and discussed among all team members so that the team can draw their conclusions for the final decisions. As a result, these activities can be considered as a mean to convert tacit into explicit knowledge as mentioned by Nonaka [25]. During this stage, it is important for the TRM operation team to engage themselves in open dialogs to enhance the team's learning process [31,32].

TRM support team: Being a resource center, the TRM support team must assemble all necessary information and maintain all communication channels open, so that the information can be shared and exchanged.

4.3. Integration stage

The development of a technology roadmap alone is not enough to sustain it. The roadmap implementation needs to be seen as an ongoing process with continuous review and update of drivers, technologies and the map itself [17]. Therefore the integration of roadmapping processes into the current business operation in any organization is the key to sustainability. The following section will discuss the roles and responsibilities of the key players in this stage.

The idea champion: The final role of the idea champion is to initiate the integration process of the technology roadmap into an ongoing business process. The sole responsibility of the idea champion is to oversee the integration and continue to provide assistance and support to the champion team. Finally, with completion of the TRM integration, the role of the idea champion changes into a TRM Sponsor, who is no longer involved in the process, but will remain in an advisory capacity.

The champion team: With the decreasing role of the idea champion, the champion team will pick up the pace of integrating the roadmap into the organization's ongoing business processes. It might be necessary to redesign or remove redundant processes along the integration. With the successful integration, the challenge of the champion team is to keep the TRM process alive.

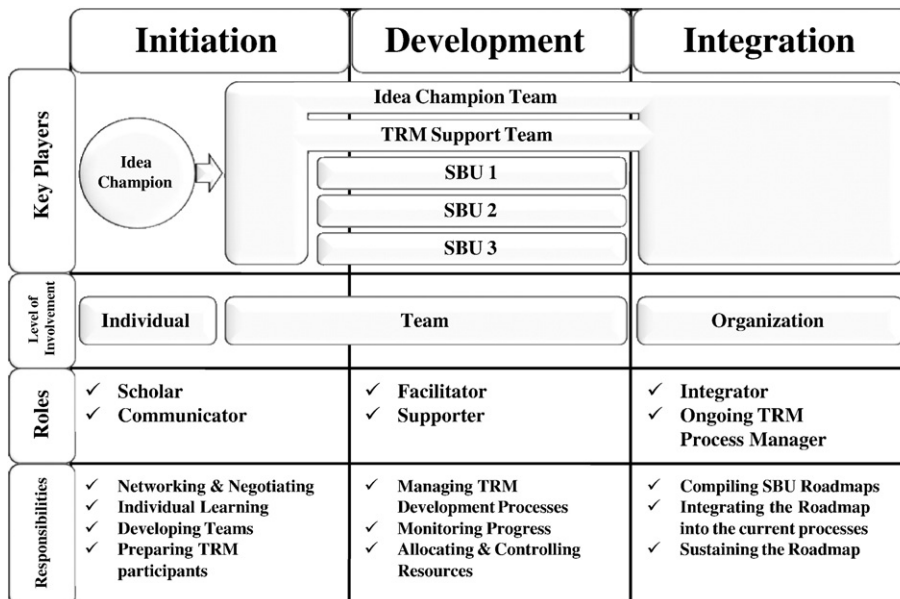


Fig. 3. Dynamics of technology roadmap implementation.

Therefore, in addition to the roles and responsibilities as described above, the individual champion must be in charge of preserving the roadmap and ensuring its continuation.

TRM operation team: At the beginning of this stage, the team will assist the champion team in verifying and validating their roadmap. As the roles and responsibilities of TRM operation team gradually decline, they still help the champion team to create linkages between TRM process and the current business processes of the organization. With successful completion of the integration stage, the TRM operation team is embedded into the organization's ongoing business processes. Finally, the team's roles and responsibilities change to update and adjust their technology roadmap.

TRM support team: The support team is responsible for preparing and collecting documents produced by the TRM development process. Apart from these tasks, the team also assists the champion team in compiling all SBU roadmaps into a corporate master roadmap. Lastly, the team has to diffuse the knowledge and lessons learned from the process throughout the organization. The idea of knowledge diffusion in this stage can be referred to Nonaka's concept on knowledge creation where tacit knowledge must be transformed into explicit and is then distributed throughout the organization [25].

5. Dynamics of TRM implementation

The roles and responsibilities of the key players are dynamic and continuously changing along the three stages of the TRM implementation as presented in Fig. 3. These changes must be carefully considered to align with information and task required at each stage.

6. A case example on applying Technology Roadmapping (TRM) approach at the SCG Building Materials Co

6.1. Company background

SCG Building Materials Co., Ltd. is the holding company for the Siam Cement Group's Building Products business. The company is Thailand's largest manufacturer of building products and a leader in the ASEAN region. The company has multiple strategic business units (SBUs) such as roofing, fiber cement board, ceramic tile, sanitaryware companies. Its products have been widely recognized for the high quality by customers both in local and international markets. The business has also continuously developed its organization competency to maintain its leadership in the construction materials industry. Several market research activities have been initiated with special emphasis on fulfilling customers' requirements and satisfaction.

As the new strategy of Siam Cement Group emphasizes high value product and service, SCG Building Materials recently announced its new vision to focus on "creating better habitat solutions for all". To complete this new vision, the company decided to reform itself from being a product manufacturer to becoming a total system provider. For example, a bathroom system is associated with a series of products and services including sanitaryware and accessories, ceramic tiles, installation methods and fixing tools, etc. Therefore, the development plan for those products must be integrated into systems in order to provide the better solutions of future home concepts to customers.

6.2. The company's objective and motivation in applying TRM approach

As SCG Building Materials aims to transform itself to become a total product/service provider, the company sees the needs to exploit more advanced technologies to deal with the increasing complexity in the operation. Moreover, the company also desires to develop product/technology platforms, which different SBUs can share in common.

Currently, the company carries out two types of business planning. One is a high-level strategic plan known as a medium-term plan (MTP). The other is an annual action plan. MTP addresses the company's strategic issues regarding its future direction for the next five

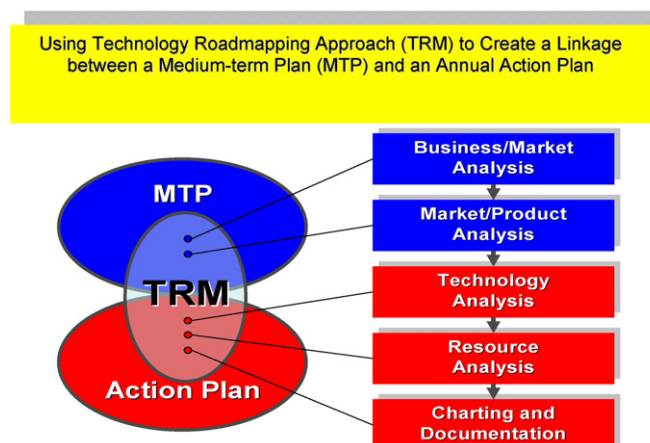


Fig. 4. The company's objective and motivation in applying in TRM.

years. The content of MTP covers the plan for the development of new products, new markets, as well as new business operations. On the other hand, the content of annual action plans covers activities with estimated budget and ownership assignment. The completion of activities in annual action plans would achieve the strategic objectives as indicated in a MTP for each upcoming fiscal year.

The two strategic plans have been effectively used to manage the development of the company's technological and manufacturing capabilities required for new product development. However, with the new vision of becoming an industry leader in providing a total housing system solution, several SBUs must collaboratively work to assure that their products would be seamlessly integrated into a system and flawlessly function together. As a result, the company has to spend longer time in R&D before being ready to launch a new product system solution than the duration the company is used to spend when each SBU develops and launches its own products, independently.

The company is considering the potentials of applying technology roadmapping in conjunction with its medium-term plan and annual action plan (as shown in Fig. 4) so that the company can emphasize identifying potential products, system, and services, map them onto technology alternatives, and develop resource allocation plans. By applying TRM approach, the company will be able to ensure that the required technologies and infrastructures will be ready when needed. Moreover, the activities conducted by various SBUs in delivering their products to support a new product system could be synchronized so that the solution can be launched in a timely manner.

6.3. The company's approach for TRM implementation

The technology roadmap development project was carried out at the beginning of 2006 after a three-month preparation. The company's ultimate objective was to have a corporate master roadmap representing the future direction of all major strategic

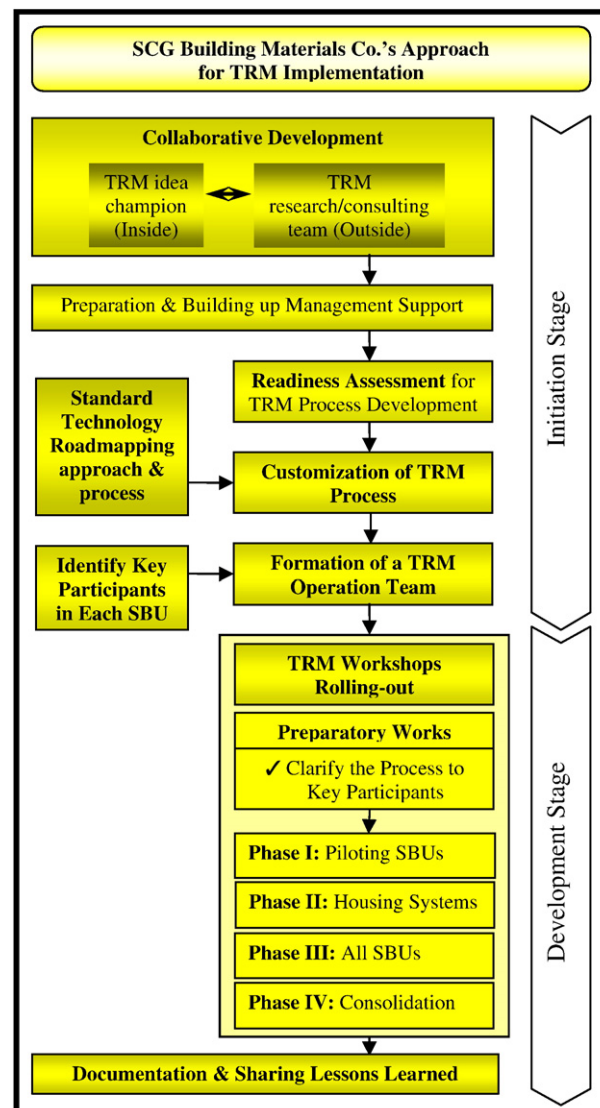


Fig. 5. The company's customized approach for TRM implementation.

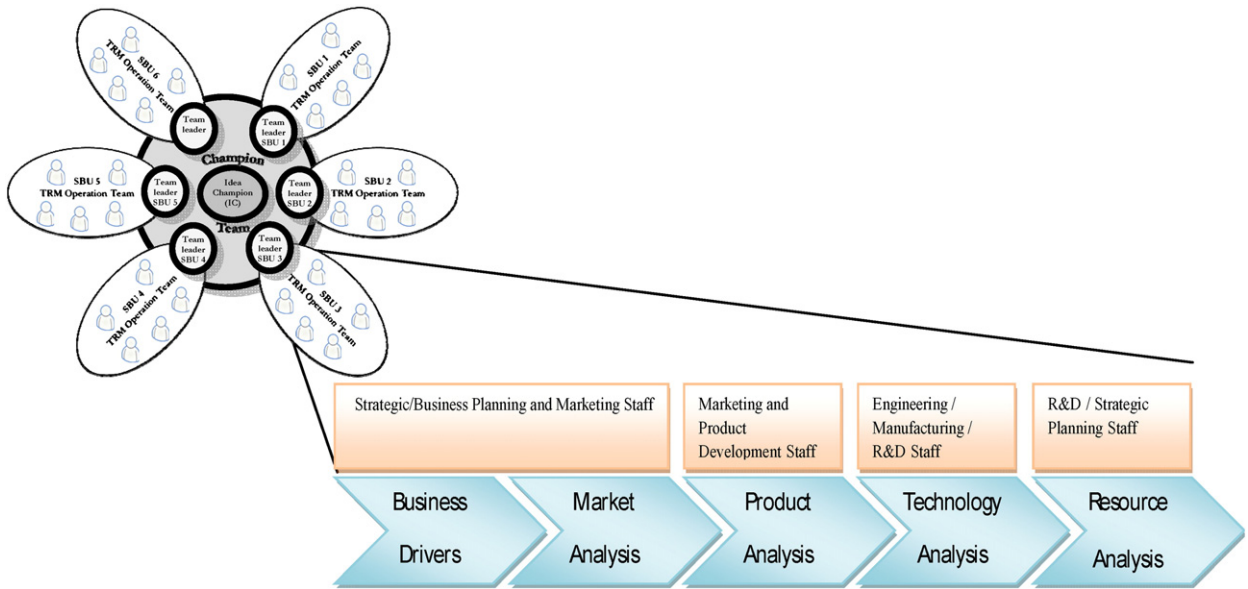
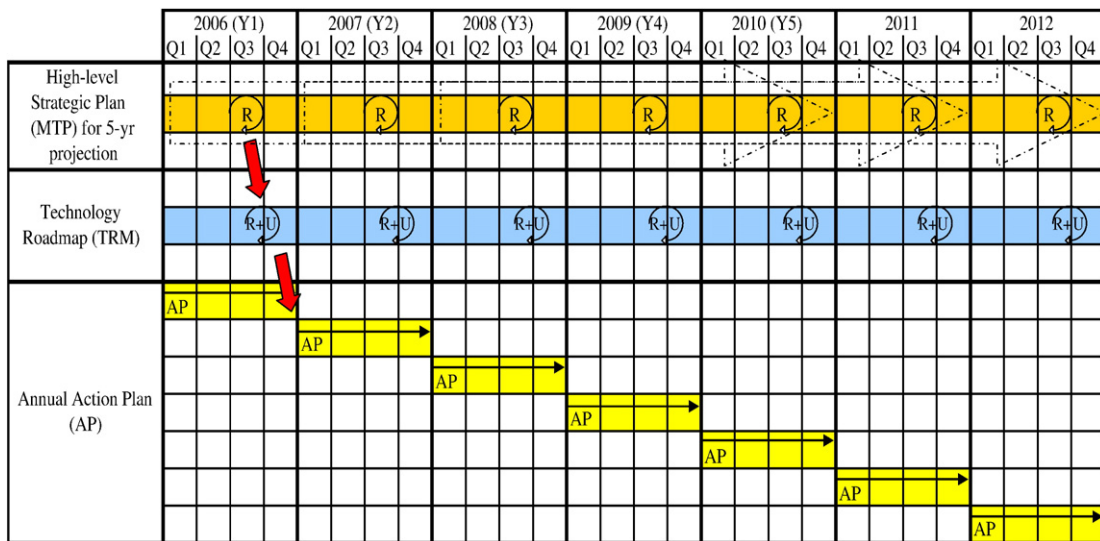


Fig. 6. Interaction of Key players from each SBU along the TRM process.

business units (SBUs). The following sections review the activities that were exercised along the three-stage approach of TRM implementation; initiation, development, and integration, as mentioned earlier.

6.3.1. Initiation and development stage

The company decided to develop a product-technology roadmap for each strategic business unit and then compile them at the end to represent as a corporate master roadmap. The external TRM research/consulting team was brought in to work with the internal team to set up the plan and facilitate the TRM process. The TRM development was designed for execution in four phases to effectively roll out the activities and build up a quick buy-in from the key stakeholders. Phase I was considered as a pilot execution aimed to introduce TRM process for the development of a product-technology roadmap in a couple of pioneering SBUs. Phase II was to expand the scope of TRM development from a product into a housing system solution. Phase III was a mainstream execution aimed to launch TRM process to the rest of SBUs. Phase IV was a roadmap consolidation aimed to integrate roadmaps from all SBUs and develop a high-level corporate master roadmap. Fig. 5 presents the company's approach for TRM implementation.



Remark: R-review, U-update

Fig. 7. A timetable representing the schedule for reviewing and updating the plans.

At the beginning, the leader of TRM research/consulting team worked closely with the idea champion, a person who sees the value of technology roadmapping process and tries to bring it into his/her organization. The idea champion helped the research/consulting team to understand the company's requirements for TRM implementation, work culture, and potential limitations, which may occur during the implementation. The idea champion and the research/consulting team worked together to set up a workshop plan. The idea champion communicated with other key stakeholders to rally their buy-in and support. Since it was the first time that the technology roadmapping concept was introduced to the company, the idea champion had to communicate with the top management regarding the balance of the expectations between a learning process and a high quality of roadmap content. The kick-off meeting for TRM implementation was organized. The President of the company was invited to inform his staffs about the needs and expected benefits from TRM implementation.

Two SBUs were chosen to implement TRM process in Phase I as they seemed to be ready and welcome to challenges. The TRM operation teams were formed for both SBUs. The team leader was appointed to be a project manager of each SBU team. As a part of Asian culture, seniority is still an issue; therefore, the ideal team leader should have not only a strong commitment on the expected values of TRM, good communication skills, but also sufficient seniority. Moreover, the idea champion should have a strong influence to recruit/invite appropriate participants. The operation team of 6–8 members was assembled from key staffs involved in strategic planning, marketing, product development, engineering, and R&D activities in each SBU.

The research/consulting team conducted an initial need assessment for each SBU so that the design of TRM process can be properly customized in order to match with the types of information available. In a case that the needed information was not available, the research/consulting team gave advice to the TRM operation teams to temporarily substitute that information with the team's judgments during the workshop sessions and then came back with the complete information later on. This approach would help keeping the momentum of team to continue through the TRM process without any interruption. The interaction among idea champion, SBU team leaders, and SBU operation teams is shown in Fig. 6.

The research/consulting team prepared a step-by-step workbook with examples for distribution in the workshops. Some members of research/consulting team took a role as facilitators to deliver the TRM process to create a dynamic atmosphere during the workshop sessions, so that the members of the working team can challenge each other on the related issues.

The whole TRM process in Phase I lasted for six months covering the analysis on business drivers, market opportunities, new product development, technology alternatives and solutions, and resource allocation, sequentially.

6.3.2. Integration stage

After completing the development stage, the ownership of TRM process was transferred from the initial idea champion to two key stakeholders in the company. One is the business planning manager who is the process owner of business planning activities. The other one is the 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 planning process of MTP and action plans. Some redundant activities exercised among these three plans were removed so that the whole analysis process could be smoothly connected.

A roadmap is scheduled to be periodically reviewed and updated between the third and fourth quarter of each year after the MTP review and before the development of an action plan for each year as shown in Fig. 7.

6.4. Dynamics of TRM implementation: an observation from the case example of the SCG Building Materials Co., Ltd

The dynamics of TRM implementation can be addressed from various aspects, for example, the change on the level of involvement and the change on the roles and responsibilities of key players through different stages of the TRM implementation as previously shown in Fig. 3. In addition, the dynamics of TRM implementation can also be addressed by the change on the degree of involvement of each key player. In this research/consulting project, the research team has observed that patterns of the change on the degree of involvement of each key player can be conceptually illustrated along the three stages as shown in Fig. 8. This pattern can be elaborated as follows.

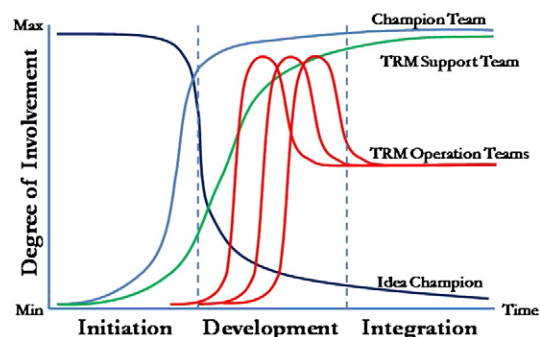


Fig. 8. Conceptual illustration of the changes on the degree of involvement for each key player throughout different stages of the TRM implementation.

During the initiation stage the idea champion is the one who provides the momentum for the implementation, by forming key teams and training them to be ready for the TRM implementation. While other key players begin to learn and understand the TRM implementation process, the idea champion is communicating with key stakeholders to promote the concept of TRM to secure support and vital resources.

With the development stage the idea champion hands over most of the responsibilities to the champion team and assumes a supportive and advisory role. His/her main function here is to monitor the TRM development and, if necessary, adjust the process or material. As the TRM development commences the involvement of the operation team peaks. This is the stage where knowledge is being created and transferred, to formulate the roadmap.

Once the roadmap has been developed and the integration stage has begun, the idea champion assumes the role of a TRM supporter in a pure advisory function. Now the focus lies on the champion team and TRM support team to compile all the business unit roadmaps into a master roadmap and to integrate the TRM process into the ongoing business processes of the organization. At this stage the TRM operation team's role moves from developing the roadmap to assisting the integration effort. With successful integration, each idea champion of the champion team will assume ownership of the TRM process in their corresponding business unit and lead the TRM operation team in maintaining and updating the roadmap as part of their daily operations.

7. Conclusion

The implementation of technology roadmapping is a complex process for the organization. The classification of the implementation process into three stages (initiation, development and integration) helps the key players to understand the unique requirements and the level of involvements in each stage. To exploit the dynamics of TRM implementation, it is essential to get key players involved at different levels across multifunctional departments. Roles and Responsibilities of each player vary throughout the process. Therefore, to understand what their involvement should be focused on and how their involvement will evolve over time is critical for the key players. With the clear understanding of the dynamic linkage and relationship among individuals and groups, TRM implementation can be strengthened and knowledge can be more effectively shared and transferred. As a result, this will lead to a higher chance of a successful TRM implementation.

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Nathasit Gertsri Ph.D. is a full-time faculty at College of Management, Mahidol University (Thailand). Currently, his TRM research is focused on how to operationalize technology roadmapping process. His research activities are carried out through academic and consulting projects. He received Ph.D. from Dept. of Engineering and Technology Management, Portland State U. A part of his dissertation on the development of technology development envelope (TDE) for roadmapping of emerging technologies was nominated to receive the outstanding paper award at PICMET in 2005. Prior to these, he worked for Intel's R&D lab in Hillsboro, Oregon.

Ronald S. Vatananan is a Ph.D. student at the College of Management, Mahidol University (CMMU) Thailand. His research interest is in the area of technology roadmapping with a focus on measuring the changes of market and technology drivers and mapping them into TRM process. Prior to his Ph.D. Studies, Ronald spent over 10 years in various management positions in Germany and Thailand. After joining the college, he became a part of the research/consulting team on technology roadmapping where he gained experiences in implementing TRM process for organizations.

Sasawat Dansamasatid is an alumnus of MIT Sloan School of Management. He has been with the Siam Cement Group for more than 10 years starting from technical to management. Currently, he is an organization development manager of SCG Building Materials Co., Ltd. He is responsible for implementing technology roadmapping initiatives, strategic product innovation programs, and coaching/leadership development programs.