Sasin Sharpening Minds, Shaping Leaders, since 1982 2008

Sasin Journal of Management

Volume 14, Number 1, 2008 ISSN 0859-2659

Nathasit Gerdsri & Sasawat Dansamasatid

Applying Technology Roadmapping to Drive the Strategic Medium-term Plan into Action: Lessons from the SCG Building Material Co.

This paper presents the technology roadmapping (TRM) approach implemented at SCG Building Materials Co., Ltd., Thailand's largest manufacturer of building products and a leader in the ASEAN region. By applying the TRM process, the company aims to create a better integration between business and technology strategy as well as a seamless linkage between the company's strategic medium-term plan and annual action plan. The results guide the company to plan and manage its innovation and new product development activities by using a cross-functional approach. The success of these endeavors strategically supports the company for its mission to provide the "better solutions of future home concepts to customers". In this paper, the first two sections briefly cover the fundamental concepts of TRM. The latter sections elaborate on how the company customizes the TRM implementation approach and adopts it as a part of the company's ongoing business process.

I. Introduction

The main objective of technology roadmapping (TRM) is to integrate science/technology development into product and business aspects. Since its earlier introduction, as a concept, by Robert Galvin, a former Motorola chairman, in the late 1970s, technology roadmapping has been evolving as a new practice in technology management (Willyard and McClees, 1987). Currently, the roadmapping concept is widely adopted in industry, government, and academia for providing a way to develop a technology strategy, identify gaps and opportunities in R&D, and plan for resource allocation (Albright and Kappel, 2003; Probert, 2003; Kostoff and Boylan, 2004; Richey and Grinnell, 2004; Wells, Phaal, et al. 2003).

Some organizations apply TRM as a vision guiding exercise where the key deliverables presented in a roadmap are the future direction on which the major stakeholders in each organization agree. Other organizations apply the TRM approach more extensively as they use it as a part of a strategic planning exercise to identify the potential products/services to market and determining the proper supporting technologies. The results are also carried out for resource allocation and budgeting.

To keep a roadmap updated under today's fast-changing environment, the company must plan the activities to periodically verify its roadmaps and adjust them in a timely manner. The results of the field survey conducted by the Institute of Manufacturing, University of Cambridge indicated that the key challenge for technology managers in implementing TRM

Nathasit Gerdsri, Ph.D. is a full-time faculty at College of Management, Mahidol University, Bangkok, Thailand and Visiting Assistant Professor in Department of Engineering and Technology Management at Portland State University, U.S.A.; Sasawat Dansamasatid is an organization development manager of SCG Building Materials Co., Ltd., Siam Cement Group, Bangkok, Thailand.

is to "keep a roadmap alive" (Phaal, Farrukh, et al. 2000).

This paper addresses the fundamental concept of technology roadmapping and how a company customizes the TRM implementation approach. In addition, the paper emphasizes the needs of integrating the technology roadmapping process as a part of the company's ongoing business process so that a roadmap can be kept alive. The success results in the better integration between business and technology strategy and the seamless linkage between the company's strategic medium-term plan and annual action plan.

II. Technology Roadmapping (TRM)

Overview

"Roadmapping" and "Roadmap" are words describing the process and the product of the roadmapping process, respectively. Technology roadmapping is simply defined as a process to portray the integration of science/technological considerations into product and business planning as well as to provide a way to identify, evaluate, and select alternatives that can be used to achieve a desired objective. The popular applications are for developing strategies, planning resources, and identifying gaps and opportunities in R&D.

Robert Galvin (1998), former Motorola Chairman and advocate of science and technology roadmaps, said "A roadmap is an extended look at the future of a chosen field of inquiry composed from the collective knowledge and imagination of the brightest drivers of the change."

A roadmap, a product of the roadmapping process, is generally presented in the form of a time-based diagram with multi-layers linking technology-related issues to business decisions. The systems thinking approach must be applied to analyze the change of elements—business, markets,

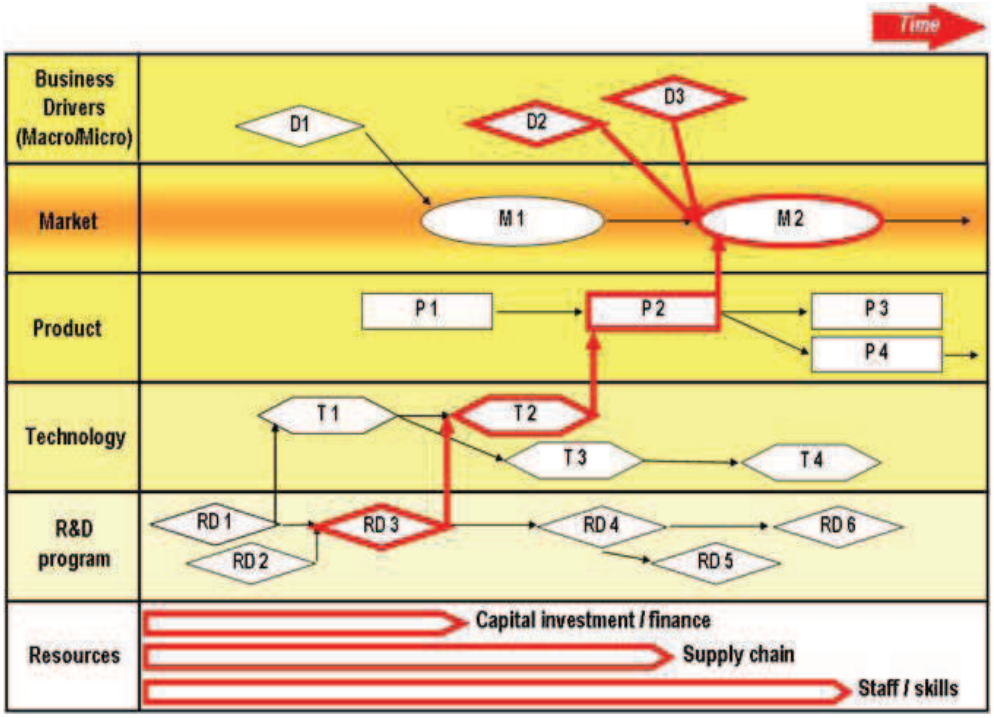


Figure 1: A Generic Product-technology Roadmap

products, technology, R&D, and resources—and the impacts of those changes on an organization over time.

Figure 1 presents a generic form of a product-technology roadmap. In this roadmap, business drivers D2 and D3 are determined to be key forces that will drive business changes in the future. These changes would lead to a potential market opportunity as presented by M2 on the diagram. To capture this opportunity, an organization plans to launch a new product called P2 of which the design and development requires a new technology known as T2. An organization also needs to invest in research and development activities, RD3, to make T2 ready for use by the time it is needed.

The Step-by-Step Analysis Supporting the Development of a Roadmap

To develop a product-technology roadmap as presented in Figure 1, the analysis of the TRM process can be divided into five steps addressing business drivers, market opportunities, product, technology, and resource, respectively. The objective of each analysis step is presented in the table below.

General Approach for TRM Implementation in an Organization

Gerdsri and Vatananan (2007) proposed to classify the approach of TRM implementation into three stages: initiation, development, and integration.

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

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

3. *Integration stage* aims to integrate the TRM process into 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 implemen-

Table 1: The Objective of Each Analysis Step Supporting the Development of a Roadmap

Analysis Step	Objective
Business Drivers	Identify forces/drivers shaping the future of our industry and assess the criticality of their impacts
Market Opportunities	Determine potential market opportunities to focus under the future circumstance as anticipated
Product	Specify the right products and their market timing to supply in the new market opportunities
Technology	Select the proper technologies used in the development of new products
Resource	Develop a resource allocation plan supporting the development of technological capabilities

tation effort can stop after the development stage is completed. However, for some organizations that want to assimilate the TRM process into their ongoing business operations, they need to continue with the integration stage. The detailed explanation of the main activities conducted though each stage is described as follows:

Initiation Stage

It is important for any organization to start off with the right approach. The purpose of this stage is to form a core team led by an idea champion. An idea champion is a person who sees the value of the technology roadmapping process and tries to bring it into his/her organization. Also, an idea champion should understand the company's work culture and potential limitations which may occur during the implementation. The members of a core team should prepare themselves to understand 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 about the technology roadmapping concept 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 how the generic TRM concept can be customized to fit into the strategic planning process and the organization's working culture.

Development Stage

The main emphasis during this stage is on data collection and analysis. TRM workshops are arranged to analyze data and graphically present the results in roadmap form. The workshop participants are the members of the TRM operations team headed by their idea champion. The collection of data can be done both internally and externally. The main functions of the workshops are not only to analyze data, but also to share and transfer knowledge among participants.

Integration Stage

With the completion of the development stage, the focus of the implementation will be moved to the integration of the roadmapping process. The objective is to put the technology roadmapping process into an ongoing business operation. This integration is vital, since the TRM initiative is not a one-time implementation but rather an ongoing process (Kostoff and Schaller, 2001). During the integration stage, the main roles and responsibilities are transferred to the idea champion team. The aim and desired result are 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.

Key Success Factors in TRM Implementation

Critical components to the success of TRM implementation are people, processes and data. The implementation needs to be carefully planned, especially in aligning the right people and resources into the process (Gerdsri and Assakul 2007). The dynamics of TRM implementation also need to be addressed so that participating individuals and teams can adjust their roles and responsibilities along the periods of TRM implementation (Gerdsri and Vatananan, 2007). Associated with the above three components, the following is the summary of factors contributing the success of TRM implementation.

1. *Clear Business Needs:* A roadmapping initiative must have a clear sense of purpose and ownership (Australian Dept. of

Industry, Science, and Resources, 2001). This would help to gain commitment from all participants.

2. *Commitment from Senior Management:* The commitment from senior executives must be publicly acknowledged in an organization. The rewards and incentives to encourage bottom-up support from people participating in the roadmapping process may also be necessary (Australian Dept. of Industry, Science, and Resources, 2001).

3. *Right People/Functions Involved:* Champions must be identified to coordinate, drive, and obtain buy-in from other key stakeholders (McMillan, 2003). Champions must have motivations for credible and visionary roadmaps (Kostoff and Schaller, 2001). A multifunctional team (size 3-35) should be formed to implement a roadmapping process. The members of this group should be diverse but have relevant knowledge and background to the subject (Phaal, Farrukh, et al. 2003). Participation should be broadened to both disciplines and technologies that have the potential to introduce innovations in the future. The roles and responsibilities of each player must be clearly defined. The continuity of participation is desirable, at least for a core set of participants (Phaal, Farrukh, et al. 2000).

4. *Desire to Develop Effective Business Processes:* All key stakeholders and participants must be convinced on how roadmap activities will help to achieve the vision and industry goals and also improve the bottom lines of individual players (Australian Dept. of Industry, Science, and Resources, 2001). The business units have to endorse and own the process in order to achieve maximum benefit for the company (McMillan, 2003).

5. *Company Culture Supporting Group Participation in the Process:* Strong leadership is required (U.S. DOE, 2002). The leaders for TRM implementation must set the boundaries and constraints for the scope of roadmaps. They are also responsible for determining the structure of the working groups (Australian Dept. of Industry, Science, and Resources, 2001).

6. *Timing and Planning of the Initiative:* The scope of TRM implementation needs to be pre-defined covering the unit of analysis, focus, resources, venue, scheduling, participants, and available information (U.S. DOE, 2002; Phaal, Farrukh, et al. 2003). The major costs incurred during TRM implementation is the time that individuals spend in developing and reviewing the roadmap. The costs and commitments required from participants to the process should not be underestimated (Kostoff and Schaller, 2001).

A game plan covering purpose, background information, workshop preparation, and follow-up activities should be set in advance. The workshop sessions need to be planned with adequate time for participants to determine technological needs, explore issues and set up a priority through cross-cutting discipline analysis.

7. *Clear and Effective Process for Developing an Ongoing TRM:* The structure and process need to be customized to fit the particular company context and extended purpose (McCarthy, Haley, et al. 2001; Albright and Kappel, 2003; McCarthy, 2003; Phaal, Farrukh, et al. 2003). The normalization and standardization of the process should be considered across different roadmaps (Kostoff and Schaller, 2001).

8. *Effective Tools, Techniques, and Methods:* A set of common tools and templates with simple language must be prepared (Albright and Kappel, 2003). The criteria for filtering, rating, and prioritizing need to be defined (Kostoff and Schaller, 2001; McMillan, 2003). For example, the scales used for measuring the impact of social and economic changes on the business need to be clearly defined and agreed among the team members. Also, the criteria for evaluating and selecting proper technologies need to be clearly described.

9. *Effective Facilitation and Training:* Both TRM participants and management need to be educated and trained to properly use and apply roadmaps (Kostoff and Schaller, 2001; McMillan, 2003). A workshop environment should be conducive to creative thinking and spur participants to share their ideas for the future.

10. *Required Data, Information and Knowledge:* The types and reliable sources of information used for TRM analysis need to be specified at the beginning (Kostoff and Schaller, 2001; Phaal, Farrukh, et al. 2003). The data analyses must be exercised in a systematic process. A wide range of science and technology knowledge disciplines must be considered along with social science (McCarthy, Haley, et al. 2001). Building databases of roadmap information is also important as the process of TRM implementation becomes ongoing activities (Albright and Kappel, 2003).

III. Applying Technology Roadmapping (TRM) Approach at the SCG Building Material Co.

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, and sanitary ware companies. Its products have been widely recognized for high quality by customers in both local and international markets. The business has also continuously developed its organizational 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 a new strategy, 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 become a total system provider. Now, customers would pay a single fee to the company which covers the combination of individual product elements and the installation services. For example, a bathroom system solution is associated with a series of products and services including sanitary ware and accessories, ceramic tiles, installation methods, fixing tools, and more. With a single fee, customers would get a fitted and furnished bathroom.

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 development plan for those products has to be synchronized and integrated into a master plan for the total solution development. The company also sees the needs for exploiting more advanced technologies to deal with the increasing complexity in the operation. Moreover, the company also desires to develop a common product/technology platform which different SBUs can share.

Currently, the company conducts 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 years. The content of MTP covers the plan for the development of new products and new markets, as well as new business operations. On the other hand, the content of action plans covers activities with estimated budget and ownership assignment. The completion of activities in action plans would achieve the strategic objectives as

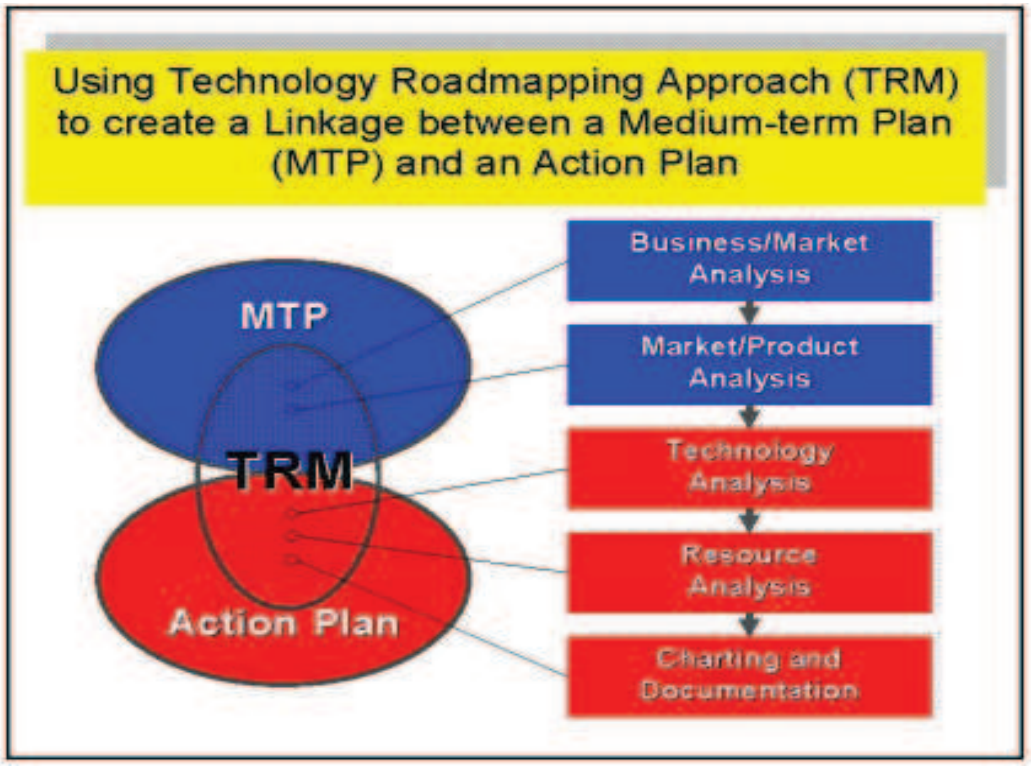


Figure 2: The Company's Objective in TRM Implementation

indicated in a MTP for each upcoming fiscal year.

The two strategic plans have been efficiently 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 a longer time for R&D before being ready to launch a new product system solution, longer than the time the company is used to spend when each SBU developed and launched its own products independently.

The company is considering the potential of applying technology roadmapping in conjunction with its medium-term plan and annual plan (as shown in Figure 2) so that the company can identify potential products, system, and services, map them onto technology alternatives, and develop resource allocation plans. By applying a 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.

The Company's Approach for TRM Implementation

The technology roadmap development project was carried out in 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 business units (SBUs). The following sections review

the activities that were exercised by presenting it along with the three-stage approach of TRM implementation: initiation, development, and integration, as mentioned earlier.

Initiation and Development Stages

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. To effectively roll out the activities and build up a quick buy-in from the key stakeholders, the TRM development was designed to execute in four phases. Phase I was considered as a pilot execution aimed to introduce the TRM process for the development of a product-technology roadmap in a few 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 the TRM process to the rest of the SBUs. Phase IV was a roadmap consolidation aimed to integrate roadmaps from all SBUs and develop a high-level corporate master roadmap. Figure 3 presents the company's approach for TRM implementation.

At the beginning, the leader of the TRM research / consulting team worked closely with the idea champion. 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 for 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 the TRM implementation was organized by inviting the president of the company to inform his staff about the needs and expected benefits from TRM implementation.

Two SBUs were chosen to implement the TRM process in Phase I as they seemed to be ready and welcome 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 a strong commitment on the expected values of TRM, good communication skills, sufficient seniority. Moreover, the idea champion and the team leader from each SBU should have strong influence to recruit/invite appropriate participants. The team of 6-8 members was assembled from key staff involved in strategic planning, marketing, product development, engineering, and R&D activities in each SBU.

The research/consulting team conducted an initial needs assessment for each SBU so that the design of the TRM process can be properly customized in order to match with the types of information available. In 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 come 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 the idea champion, SBU team leaders, and SBU operation teams is shown in Figure 4.

A step-by-step workbook and examples were also distributed in the workshops. The facilitator and members of research team helped creating a dynamic atmosphere during the workshop sessions so that the members

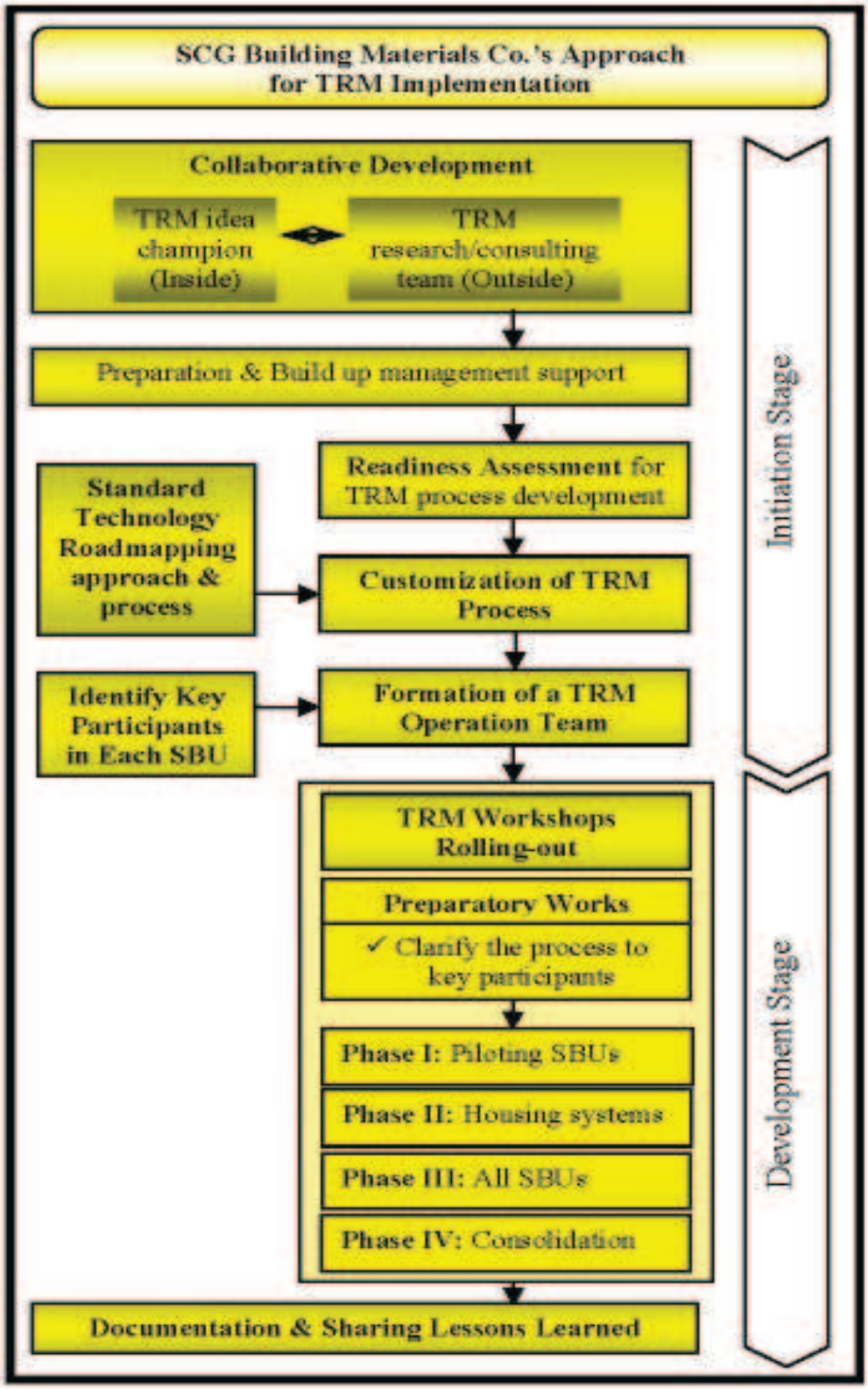


Figure 3: The Company's Customized Approach for TRM Implementation

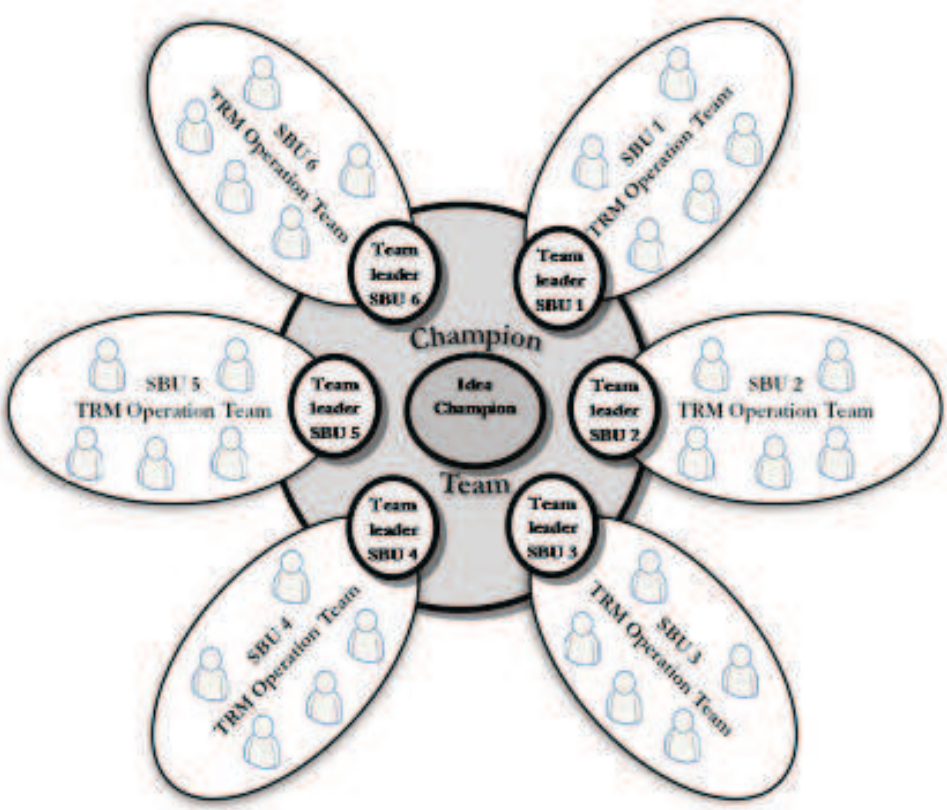


Figure 4: Interaction among Idea Champion, SBU Team Leader, and SBU Operation Team (Gerdsri and Vatananan, 2007)

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. Recently, the company began to extend their work into Phase II and III. The company expects to complete through all four phases in two years.

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 among the 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 Figure 5).

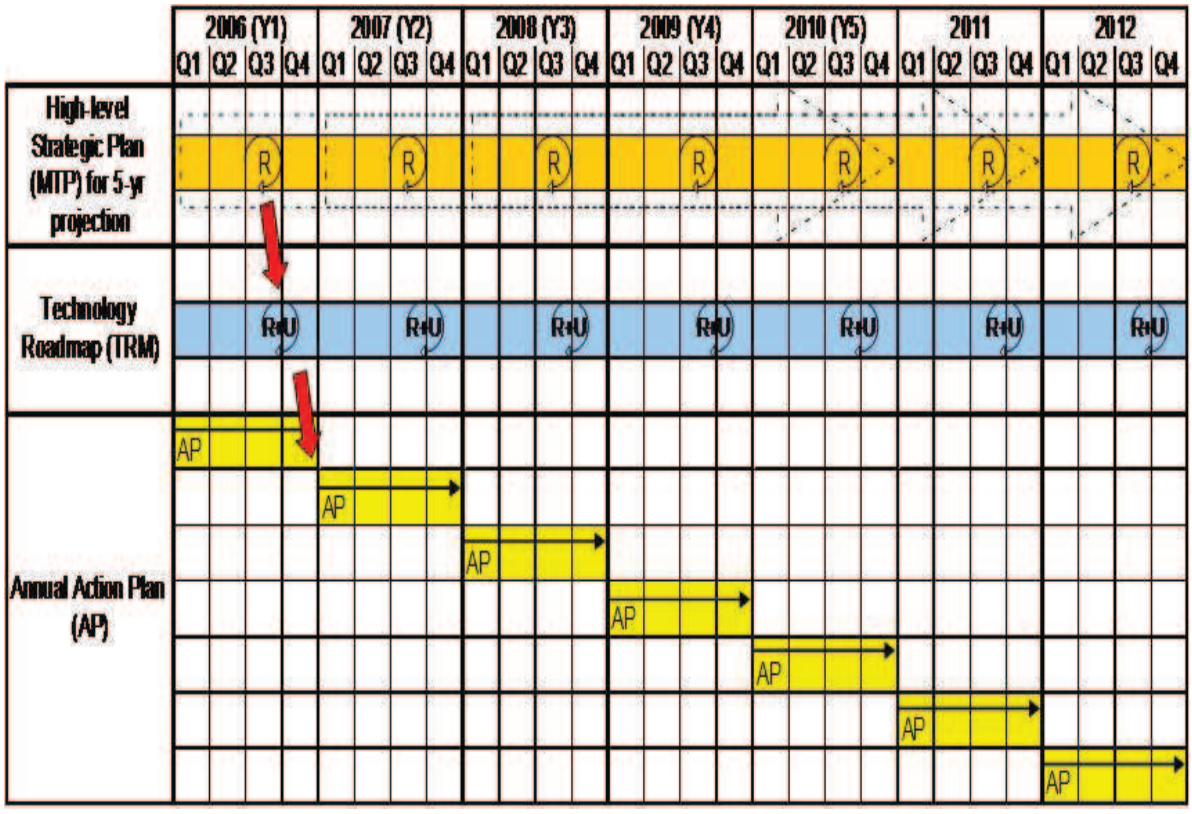
Lessons Learned

The implementation of technology roadmapping allows the company to be able to focus its strategic continuity on technological capability development. Without TRM, it would be quite challenging for the company to manage different SBUs to collaborate and develop a shared-product strategy for delivering a new housing system solution in a timely manner. In the long run, the development of a roadmap would help strengthen the company's strategic direction in leveraging R&D investments as well as managing technologies for innovation.

In addition to the benefits that the company gained from TRM implementation, the authors, participating teams, and organizations have learned several lessons from our TRM engagement with several SBUs. Our lessons can be summarized as follows:

1. Identifying the right idea champion is crucial as he/she is the one who understands the needs why an organization has to implement TRM. This person is a key link to communicate with the top management about the matters as well as to rally for buy-in from key stakeholders who will participate in the process. A great deal of leadership is required.

2. Having a management commitment



Remark: R-review, U-update

Figure 5: A Time Table Representing the Schedule for Reviewing and Updating the Plans

is a high priority. This can be obtained through several activities such as arranging a company-wide meeting to kick-off the TRM initiative or setting up a special meeting to review the results after completing major milestones in the TRM development process. The strong enthusiasm and support from the management would help maintain the momentum of the working teams.

3. Conducting the initial assessment before planning the TRM implementation for each SBU is necessary since the TRM process and approach may have to be specifically customized to match with the level of readiness of each SBU.

4. Creating an open communication environment throughout the TRM development process is important so that the information can be shared among different groups of participants and verified before analyzing it.

5. Identifying a proper process owner is also necessary. As technology roadmapping becomes a part of the ongoing business planning process, it needs to be well planned so as to seamlessly integrate into the existing planning process. A roadmap needs to be periodically reviewed and updated and the timing synchronized with other business planning activities.

6. Having the right idea champion leading the team, the full support from top management, and the clear TRM process customization help minimize the resistance to change from participating members and business units.

IV. Conclusion

This paper presents the approach for technology roadmapping (TRM) implementation practiced at SCG Building Materials Co., one of the leading manufacturers in building material products in the ASEAN region. The discussions and lessons learned addressed in the paper can be used as a guideline or a case example presenting how a corporation with multiple strategic business units should prepare itself for the TRM implementation.

As the business environment is constantly changing, an organization needs to integrate the roadmapping process into its ongoing business practices so that a roadmap can be kept alive. To effectively do so, an organization must have a proper plan for resource allocation as well as the involvement and contribution of key players, especially in the integration stage.

V. References

Albright, R. E. and T. A. Kappel (2003), "Roadmapping in the Corporation," *Research Technology Management*, 46(2), 31-40.

Australian Dept. of Industry, Science, and Resources (2001), *Technology Planning for Business Competitiveness: A Guide to Developing Technology Roadmaps*.

Galvin, R. (1998), "Science Roadmaps," *Science*, 280, May, 803.

Gerdsri, N. and P. Assakul (2007), "Key Success Factors for Initiating Technology Roadmapping (TRM) Process: A Case Study of a Leading Thai Firm," *Asia Pacific Academy of Management and Business Conference (APAMB)*, Singapore.

Gerdsri, N. and R. Vatananan (2007), "Dynamics of Technology Roadmapping (TRM) Implementation," *Portland International Conference on Management of Engineering and Technology (PICMET)*, Portland, OR, U.S.A.

Kostoff, R. N., Robert Boylan, et al. (2004), "Disruptive Technology Roadmaps," *Technological Forecasting and Social Change*, 71(1-2), 141-59.

Kostoff, R. N. and R. R. Schaller (2001), "Science and Technology Roadmaps," *IEEE Transactions on Engineering Management*, 48(2), 132-43.

McCarthy, J. J., D. J. Haley, et al. (2001), "Science and Technology Roadmapping to Support Project Planning," *Portland International Conference on Management of Engineering and Technology (PICMET)*, Portland, OR, U.S.A.

McCarthy, R. C. (2003), "Linking Technological Change to Business Needs," *Research Technology Management,* 46(2), 47-58.

McMillan, A. (2003), "Roadmapping Agent of Change," *Research Technology Management,* 46(2), 40-7.

Phaal, R., C. J. P. Farrukh, et al. (2000), "Fast-Start Technology Roadmapping," *9th International Conference on Management of Technology (IAMOT 2000)*, Miami, FL U.S.A.

--------, --------, et al. (2003), "Customizing the Technology Roadmapping Approach," *Portland International Conference on Management of Engineering and Technology (PICMET)*, Portland, OR, U.S.A.

--------, --------, et al. (2003), "Starting-up Roadmapping Fast," *Research Technology Management*, 46(1-2), 52-8.

Probert, D. (2003), "Frontier Experiences from Industry-academia Consortia," *Research Technology Management*, 46(2), 27-30.

Richey, J. M. and M. Grinnell (2004), "Evolution of Roadmapping at Motorola," *Research Technology Management*, 47(2), 37-40.

U.S. DOE (2002), *National Hydrogen Energy Roadmap*, National Hydrogen Energy Roadmap Workshop, Washington, DC.

Wells, R., R. Phaal, et al. (2004), "Technology Roadmapping for a Service Organization," *Research Technology Management*, 47(2), 46-50.

Willyard, C. H. and C. W. McClees (1987), "Motorola's Technology Roadmap Process," *Research Management*, September - October, 13-19. ♦