The Major Determinants for the Adoption of the Strategic Technology Roadmap (STRM) as an Infrastructure for Technological Innovation

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Abstract— This study is about the major determinants for the adoption of the Strategic Technology Roadmap as an infrastructure for technological innovation in a R&D organization. For this study, I defined the concept of the Strategic Technology Roadmap and its characteristics. I also studied the key processes of the Strategic Technology Roadmap and the major success factors for the adoption of it. The study was performed based on the theoretical study and related qualitative study approaches. The major determinants for the adoption of the Strategic Technology Roadmap can be summarized as follows; the top management support for the adoption of the Strategic Technology Roadmap, the goodness - the goodness of the fit - of the Strategic Technology Roadmap and the organizational capability for the utilization of Strategic Technology Roadmap can be the major determinants. This study regarding the adoption of the Strategic Technology Roadmap can be the good reference for the Technology R&D organization which is willing to adopt and utilize the Strategic Technology Roadmap in the future.

I. INTRODUCTION

In this global hyper-competitive business environment, many technology-savvy organization which regards the R&D as future growth engine is trying to adopt the Strategic Technology Roadmap(STRM) for the integration of the strategy and R&D system. Strategic Technology Roadmap can be the powerful technology strategy tool for the future technology development and align the business strategy with the R&D projects, also the infrastructure for technological innovation in the long-term perspective.

II. STRATEGIC TECHNOLOGY ROADMAP AND R&D INNOVATION

A. Strategic Technology Roadmap

In this hyper-competitive business environment, many organizations are trying to adopt the strategic technology roadmap for the integration of the strategy and R&D system. Strategic Technology Roadmap can be the infrastructure for technological innovation and direct the R&D system in a more strategic and systematic way.[8], [12], [13], [14] Particularly, Strategic Technology Roadmap(STRM) is the technology roadmap developed in the organizational level. Strategic Technology roadmap can be developed, shared, and updated in the R&D organization and can be used as a powerful technology strategy tool for technological innovation, and also for the technological exploration and exploitation in the organization.

(Figure 1) Technology Roadmap Simple Frame

It is the time to use the technology roadmap when there is a inconsistency in R&D system, there is no clear R&D vision in the organization and don't know what is the strategic core technology. Through the strategic technology roadmap, R&D
organization can align the business strategy, technology strategy and R&D system.

B. R&D System innovation through the Strategic Technology Roadmap

R&D system evolves from 1 generation to 4th generation. Generation 1 R&D system is the lab level R&D management, and the Generation 2 is the R&D project management level. The integration of the Strategy and R&D system starts from the 3th Generation R&D system and in the 4th Generation R&D system R&D system dynamics occurs spontaneously for the blue oceans.[15]

From the 3th Generation R&D system, Technology roadmap can be used for strategy-R&D integration for goal-oriented R&D project management. The general level of the Korea R&D system can be refer to as the 2.6 generation R&D system and the system level difference between the chaebol and small firm R&D system is huge. For a more productive R&D system, firstly, Strategy, R&D portfolio management and R&D project management should be aligned with each other.[16] Only after these integration, 4th Generation R&D system can be achieved. So there has been an emphasis on the strategic technology roadmap as a powerful tool for integration of the strategy and R&D system for efficiency and optimization of the technology resources. As mentioned earlier, strategic technology roadmap has the capability of the R&D optimization and R&D resource integration if it is properly utilized. By the utilization of the technology roadmap, R&D system evolves from 3rd generation to 4th generation. [15]

C. Strategic Technology Roadmap as an Infrastructure for Technological Innovation

Strategic Technology roadmap systematically links the market, product, technology and external environment. Also Strategic Technology roadmap provides the R&D organization with the technology intelligence capability and guides the technology development timing in a strategic way. [12], [13], [14] According to the 'Agent Model' in technology roadmap, 'technology nodes' and 'links' in the technology roadmap spontaneously makes innovation virtually and technologically evolves and revolves systematically. Technology Roadmap can accelerate technological innovation by the path exploration in the technology roadmap and the merge of the Macro and Micro technology roadmap. In this innovation perspective technology roadmap can be the 'living organism' which is self-organizing mechanism and evolves spontaneously for innovation. So the more the organization has the technology capability and technology resource, the more the technology roadmap made in that organization can have the innovation capability. This means technology roadmap has the innate characteristics for technological innovation and innovation dynamics.[8], [12], [13]

So, when the organization adopt the technology roadmap and utilize the roadmap in the R&D project, the characteristics of the technology roadmap can be realized and technology roadmap begin to align the strategy and R&D system and can be the catalyst for the technological innovation. When technology nodes and links in the technology roadmap converted into technology cluster and implemented in the R&D project, technology roadmap can be action-oriented living document. So Technology roadmap in the organization can be the infrastructure for innovation in the long term. [8]

D. Technology Roadmapping Process

Technology roadmapping process can be categorized as follows; First is the strategic core technology selection in the R&D organization and Second is the deployment of the technologies in the time-frame in the technology roadmap in the macro and micro level. In this study I analyzed the whole process of the adopting of the strategic technology roadmap in the R&D organization.

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<th>Stages</th>
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<tr>
<td>Stage 1</td>
<td>Select and prioritize the Strategic Core Technology in the R&amp;D organization considering the organizational external environment, internal capability and strategy.</td>
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<tr>
<td>Stage 2</td>
<td>Deploy the element technologies and sub-element technologies in the technology roadmap timeframe (Technology nodes are connected by technology links, and technological evolution easily can be detected)</td>
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Strategic Technology Roadmap can be developed in stages. To be a successful adoption of the roadmap in the organization, in addition to the top management support, voluntary participation of the R&D researcher is needed. Particularly, reaching a consensus of the R&D members regarding the strategic core technology and deployment of the key technology in the timeframe of the technology roadmap.[12], [13], [14] All these procedure of making the strategic technology roadmap should be transparent and there should be the 'procedural justice' in the organization.
1. Strategic Technology Roadmapping Stage 1: Selecting the Strategic Core Technology

In stage 1 strategic technology roadmapping Process, Firstly, strategic core technology should be selected considering the organizational external environment, internal capability and strategy. After selecting the strategic core technology, prioritization among the key technologies should be done. As mentioned earlier, most important thing in this stage is the reaching a 'consensus' regarding the strategic core technology lists. That is what is the strategic core technology in the organization in the future, and what should be done to carry the technologies. There should be the whole members participation in the organization for selecting and prioritizing the strategic core technology including the top management and R&D personnel.

(Figure 3) Example of Technology Roadmap (NTRM, 2005)

2. Strategic Technology Roadmapping Stage 2: Deployment of the key technologies in the timeframe

In stage 2 ‘strategic technology roadmapping Process’, detailed roadmap should be drawn in stages. Firstly, Core technology's technological requirement should be defined, technological analysis should be finished. Secondly, ‘Technology Tree’ of the Core technology should be drawn. Key technologies in the technology tree can be clustered and can be grouped in 'technology nodes' in the technology roadmap, so this process of making the technology tree is very important stage. Final stage is deployment of the element technologies and sub-element technologies in the technology roadmap timeframe. Technology nodes are connected by technology links, and technological evolution easily can be detected visually. According to this technology roadmap, technology development strategy can be made and R&D project action plan can be drawn. [12], [13]

III. MAJOR DETERMINANTS FOR THE ADOPTION OF THE STRATEGIC TECHNOLOGY ROADMAP IN THE R&D ORGANIZATION

A. Top Management Support for STRM

For the successful adoption of the strategic technology roadmap in the R&D organization Top management support is needed.[12], [13] Top management can be the CEO, CTO and direct the organization toward the strategy-focused organization. From the initial stage of the technology roadmapping process, Top management should emphasize the participation of the whole member of the organization, committed themselves to successful adoption of the technology roadmap and communicate with other stakes members of the organization.[4] Through the top management support regarding the whole process of roadmapping, the strategy and R&D system starts to align with each other and innovation characteristics of the technology roadmap can begin to move from roadmap to R&D project. Top management support is as follows; furnishing the personnel and material support related to roadmapping, giving the authority to utilize the roadmap, providing the information regarding the technology roadmap, emphasizing the utilization of technology roadmap in the organization and supply the rewards and incentive for it.

B. The Goodness of the Fit of the Strategic Technology Roadmap

As mentioned earlier, Strategic Technology Roadmap can be categorized as selecting the strategic core technology and deploying the key technologies in the timeframe. When developing the strategic technology roadmap, the relevance of the technology-tree of the core technology is very important. Technology nodes in the technology roadmap is the representation and standardization form of the R&D activity, technology nodes can be clustered and R&D project can be executed as per this grouped technology nodes. So technology level and technology digit of the technology tree is important factor for the successful R&D action plan. Also the technology nodes can be deployed in the Macro and Micro technology roadmap and transformed into the R&D project. In this respect, the goodness of the fit of the Strategic Technology Roadmap can be the most important factor for the successful utilization of the roadmap. The goodness of the fit of the Strategic Technology Roadmap is as follows; the relevance of the key technology and technology digit level and its links each other in the technology roadmap, the
relevance of the realization period of the technology nodes. This relevance of the roadmap should be emphasized from the beginning, continually updated for the goodness of the fit between the technology evolution and R&D project activity in the organization.

C. Organizational Capability Building for STRM

Strategic Technology Roadmap is the technology communication tool for integrating Market, Product, Technology and external environment. As a market-driven technology planning tool, technology roadmap can be the linkage pin of the market and technology. In this respect, technology roadmap T-plan developed from the market, product, and technology, workshop has been done through this stages,[12], [13], [14] So Strategic Technology Roadmap should be the integration tool for market and technology, technology information should be exchanged in the roadmap strategically. In this process technology roadmap and organization can be coupled and the innovation characteristics of the roadmap can realized in R&D activity. So relational capability of the marketing, product planning and R&D project team should be enhanced for the strategic utilization of roadmap.

IV. CASE STUDY: K COMPANY STRATEGIC TECHNOLOGY ROADMAP ADOPTION PROCESS

With the B. Berg(2004) qualitative case study method, in this study, the Strategic Technology Roadmap adoption and utilization process of the K Company was deeply analyzed. K Company is the technology-savvy organization in the competitive internet business. K Company has a vision for top company in Korea and updated regularly its long and mid-term business plan. To have a technological capability for the best internet company, K Company decided to have a concrete technology roadmap in the organization with Macro and Micro level.

From the initial stage of the technology roadmapping process, CEO emphasized the participation of the whole member of the K Company, and communicated with the R&D Personnel and engineers and technology roadmap specialists. For the Strategic Technology Roadmap, the organizational environment, technology level, technology capability, patent and competitors' technology capability was thoroughly analyzed. Firstly, emerging technology, strategic technology was selected and prioritization among the key technologies was done, finally, strategic core technology was selected. After that, the key technologies was deployed in the timeframe, and final detailed roadmap was drawn in the Macro and Micro level. In this stages the goodness of the fit of technology roadmap - the relevance of the key technology and technology digit level and its links with technology nodes was examined carefully. After the adoption of the technology roadmap in the whole organization, K Company was able to launch the more innovative service in the market. As we can see in this case study, for the successful adoption of Strategic Technology Roadmap in the organization, top management support, goodness of the fit of the technology roadmap and organization capability for the utilization of it was firstly needed.

V. CONCLUSION

In this global hyper-competition business environment, many R&D organization which regards the R&D as the future competitiveness engine is trying to adopt the Strategic Technology Roadmap(STRM) for the integration of Strategy and R&D system. Also the R&D organization can utilize the strategic technology roadmap for the innovative R&D project launching and implementation.

Strategic Technology Roadmap can be the infrastructure for technological innovation and directs the R&D toward the strategic R&D and eventually align the business strategy with the R&D system. Because of these innovative characteristics of the Strategic Technology Roadmap, many organization trying to adopt it in the whole organization. However, there has been emphasis on only the technological evolution of STRM and technological aspect of it. So strategic and systematic STRM adoption process including the top management support, considering the relevance of the roadmap and organizational capability building regarding STRM has been neglected. It is the only after the successful adoption process that Strategic Technology Roadmap can be the infrastructure for technological innovation and 'coupled' in the organization.

Nowadays, many organization are trying to adopt the technology roadmap, however, there was not enough study for Strategic Technology Roadmap. This study regarding the major success factors for the adoption of the STRM in the R&D organization can be the good reference for the organization which is willing to use the STRM in the future as a technological innovation infrastructure.

REFERENCES


