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Technology Management Strategy for Activating the Industry-Academia Cooperation

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산학협력 활성화를 위한 기술경영전략에 관한 연구

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Abstract This paper studies the technology management strategy for activating the industry-academia cooperation in open innovation environment. For this, the importance and concept of technology management balancing the internal innovation and utilization of external innovation resources, and industry-academia cooperation were theoretically reviewed. For the successful technology management in open innovation environment firms should adopt the industry-academia cooperation strategy. The technology management strategy for activating the industry-academia cooperation of the firm can be summarized as follows; Firstly, technology strategy for academia-industry cooperation utilizing the strategic technology roadmap should be prepared and executed. Secondly, the firm should adopt the open innovation system and transform their NIH(Not-Invented-Here) culture for open culture. Finally, for activating the networking with various innovation actors, industry-academia cooperation supporting system should be prepared.

요 약 본 논문은 개방형 혁신 환경하에서 산학기술협력 활성화를 위한 기술경영전략에 대해서 연구하였다. 이를 위하여 기술경영의 중요성과 개념을 고찰하였으며 내부기술혁신과 외부혁신자원의 활용과 산학협력의 균형관점에서 기술경영의 프레임을 고찰하였다. 현재 개방형 혁신 환경하에서 기업이 성공적인 기술경영을 추진하기 위해서는 기업은 산학협력전략을 추진해야한다. 산학협력 활성화를 위한 기업의 기술경영전략을 다음과 같이 도출하였다. 첫째, 현재 개방형 환경을 고려한 산학협력전략을 추진하고 실행하여야 한다. 이를 위하여 조직내 전략기술로드맵을 활용할 수 있다. 둘째, 기업은 개방형 혁신시스템을 조직내에서 도입해야 하며 이를 위하여 조직내 문화도 NIH신드롬을 극복하고 개방형으로 전환해야 한다. 셋째, 기업은 기업, 대학, 연구소 등 다양한 혁신주체들과 다양한 목적으로 협력이 가능하도록 협력을 활성화할 수 있는 지원체계를 조직내에 갖추어야 한다.

Key Words : Technology management, Industry-academia cooperation, Cluster, Open innovation

1. Introduction

Today's business environment is, so called, the hypercompetition. The hyperpecompetition can be defined as unstable condition. Stable condition is uncommon in this environment[1]. In hypercompetition, sustainable competitive advantage is eroded very frequently[1]. To survive under these circumstances, many companies focused on the core competency of the organization[2]. With the advent of the technology management(MOT), many scholars come to know that core competency is the capability of managing the core technology of the organization[3].

In addition to the inner capability of managing the core technology in organization, there is a new paradigm called

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an open innovation. With the open innovation, companies can connect the inner capability with the resources of the outside. Nowadays, technology innovation capability utilizing open innovation is needed for continuous innovation.

Nowadays in technology management study, there are many researches in the innovation management within the organization, however, there are not so many in the area of outside the organization. It is difficult for a firm which only utilizing the innovation resources within the organization, to gain a competitive advantage. Instead, in addition to the internal capability, firm utilizing the resources outside the organization can succeed in the market continuously.

So, this paper studies the technology management strategy for industry-academia cooperation. There will be a growing importance on the industry-academia cooperation in the future. In this reason, this paper present the theoretical framework for industry-academia cooperation and action strategy for it.

For the theoretical approach, this paper studies the ambidextrous technology management balancing the internal innovation and utilization of external innovation resources, and the growing importance of industry-academia cooperation in technology management field. Finally, this paper present the technology management strategy for industry-academia cooperation.

2. Hypercompetition and Technology Management

The 21st century is called, the age with continuous technological innovation, and the convergence of industry[1]. Technological innovation is the most important jargon in the 21st century, and there is a growing importance for managing the technological innovation[4]. The competition is the widespread in all of the region. The innovative new product launching means the another competition occurrence in the world. Also, the destruction of the rule of the industry(game) is the another rule for emerging industry. By the convergence of the technology, the structure of the existing industry can be deformed and the new rule of game will be applied in new industry. For example, 'Smart Grid' is the convergence technology between IT and electricity and 'Vertical Farm' is between IT, BT and NT technology. By these new convergence technology, new convergence industry will come out and the industry structure will change drastically. The pace of these change will be accelerated in the future. Due to the abrupt change and speed of it, today's environment can be defined as the very unstable state, so called, hypercompetion. This hypercompetition is drastically different from the mass production, mass consumption society[1]. In mass consumption society, gaining a competitive advantage and sustaining it is the most important issue, however, in hypercompetition, destroying the competitiveness of other competitor by new product launching is the most important issue[1]. The innovative new product launching is the most successful weapon of firm in hypercompettion[1].

The characteristics of hypercompetition is the unstable and change. This hypercompetition occurs in all industry such as consumer, aerospace, telecommunication and finance industry. The drivers of hypercompetition is the technological innovation and the convergence of industry. Fundamentally, technological innovation is the most important drivers of hypercompetition. In the future, Bio and Nano technology will be coming and due to the convergence of these technology, the hypercompetition will be accelerated in the future[1]. Because of the importance of technology and innovation, the success formula of the firm in hypercompetition is, so called, the strategic management of technological innovation[3, 4, 7]. In these age, many glorious firms already failed. For example, Kodak, Nokia already declined. During the same period, newly emerged venture such as Google, Facebook, KakaoTalk grows very rapidly seizing the business new opportunity in internet industry. Many firms searching for success formula trapped in previous success trap and failed. These firms could not see the disruptive innovation, and fail to innovate themselves to new environment[5, 6]. Kodak was the leader in film industry could not innovate their organization to new digital camera environment and failed.

Nokia, the leader in feature phone industry also failed due to the emergence of Smart Phone[31]. Instead of Nokia, Apple and Samsung dominate the new environment and Nokia trapped in feature phone industry[31]. The common denominator of failed

companies is the absence of intelligence capability outside the organization and also the negligence of organization innovation and the failure of technological innovation such as product/process innovation[5].

In contrast, the common factor for successful company in hypercompetion is the technological innovation capability based on the organization innovation capability. Another characteristics of successful company is that they have the capability for recombine various the capability, and make the new product continuously based on these core competency[2]. By these recombination of the capability, they can make the new business area and new product without stopping. Samsung is a good example of this innovation journey. New vision of CEO, continuous crisis atmosphere, and organization innovation and continuous new product launching based on core competency are the success factors for Samsung[30]. For this continuous new product launching, strategic management of technological innovation is urgently needed[4, 8]. Formulating the technology strategy and its execution of it are also needed. The routine from technology strategy to execution in organization, is required.

In addition to internal technological innovation, the capability for utilizing technological resources outside the organization is very important.

Rapid new product launching based on the capability such as outside technology adoption, strategic alliance, technology cooperation etc not to mention the internal technology development capability.

When the companies can coordinate internal capability for technology development and the capability for utilizing outside technology resources, the companies can successfully launching the new product continuously at a right time, and gain a competitive advantage. So, in hypercompetition, the success formula for a firm is the managing the technology capability 'in' and 'outside' the organization.

3. Technology Management Framework

3.1 Technology Management and its approach

Technology Management begins in the late 80s, at that time, another form of global war begins[3, 7]. All Asia counties such as Korea, Japan and China joins the global competition. With this 3rd generation globalization, technological innovation race begins[3,7]. In the 80s, the United States experience declining the industry such as car industry, and electronics by Japanese companies[3,7]. Many scholar found that the gap between and the S&T(science, technology) and Management was the reason for declining the industry. In this reason, the management of technology occurs[3, 7]. Now, technology management field develops including the technology strategy, technology project management, technology commercialization and technology policy.

This paper approaches the technology management with the perspective of disruptive innovation management, strategic top management, the whole innovation management which includes organization, product/process innovation.

The First is the disruptive innovation management perspective. When managing technological innovation, organization should always consider the disruptive innovation. Generally, technology develops through S-curve[8]. Technology emerges, develops, matures and, finally, was substituted by disruptive technology[8]. Companies recognize the importance of considering the disruptive technology, however, could not apply it to management and fails[5]. With the intelligence activity such as technology foresight and scenario planning and technology roadmapping, companies should always consider the disruptive innovation. IBM produces the report such as Global Innovation Outlook, and Global Technology Outlook continually[9]. Samsung also produces Samsung Innovation Outlook Report within the organization. Compared to huge companies such as IBM and Samsung, small medium sized companies(SMEs) can utilize the national foresight report, emerging technology roadmap, national technology roadmap as a substitute for inner intelligence activity.

The Second is the strategic top management perspective. Technology management with the strategic top management approach is different from the internal R&D management. Beyond R&D management, technology management covers the area both internal and external innovation management. Technology strategy is the technology development strategy scenario, with which

companies can launch the new innovative product continuously[10]. This concept of technology strategy covers the internal technology development and utilization of external technology resources and cooperation with other innovation actors.

Also technology strategy align the business strategy, competitive strategy, technology strategy[3,11]. In Battelle Lab, when formulating the technology strategy, in addition to considering the internal resources, they equally value the management perspective[3]. Because of the close relation between the management strategy and technology strategy, technology management should be approached by top management perspective[3].

The third is the whole innovation management which includes organization innovation and product/process innovation. Many people think that there is a huge gap between organizational innovation and technological innovation. But, for a successful technological innovation, organization innovation management is equally important. It is only after the successfully innovating the organization that technological innovation management such as product/process innovation can be possible. Through innovating the organization, the old routine for technological innovation can be abolished and, the new routine suited for the creative technological innovation can be properly established. For example, In Samsung, President Lee Keun Hee in 1994 in the Frankfurt meeting declared new vision and asserted like this "Change everything without the wife and children" With this new vision, Samsung firstly innovate the organization completely[30]. With the new spirit of Samsung, Samsung invested huge R&D money in semiconductor, LCD, phone business and new innovative product could be launched continuously[30].

High tech firms searching for technological exploration should focus on the organizational innovation first, and depart from the old routine of R&D and management. After that, new desirable R&D and Management routine should be established and focus on the technological innovation. With this continuous positive cycle of organization innovation and product/process innovation, organization eventually can have a competitive advantage in sustainable way.

3.2 Balancing the internal innovation and utilization of external innovation resources: Ambidextrous technology management approach

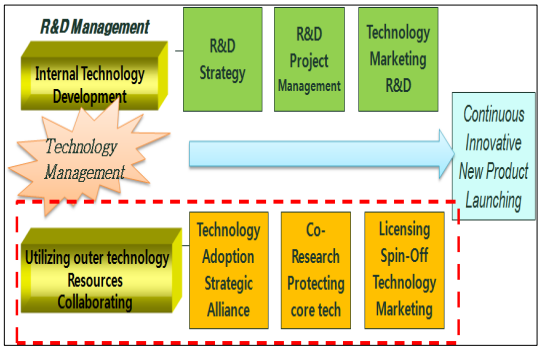
It is difficult for a firm which only utilizing the resources within the organization, to gain a competitive advantage in hypercompetition age. Instead, firm utilizing other resources from the research institute and university and other firm, can succeed in the market. In this reason, in addition to internal capability, external capability, absorbed through the absorptive capacity is regarded as valuable resources in an organization. This paper approach this ambidextrous technology management balancing the internal innovation and utilization of external innovation resources with the theory of absorptive capacity. The total capability is the sum of the internal capability and external capability through the absorptive capacity[12]. Absorptive capacity is the ability of a firm to recognize the value of new information and assimilate and apply it to commercial ends[12]. Technology management can be easily understood by this concept of absorptive capacity. With this approach, in addition to internal technology development, utilizing external resources is equally important. Internal R&D is, needless to say, important, however, utilizing external innovation resources by strategic alliance, technology adoption is very important.

For deeper understanding of the technology management for industry -academia cooperation, this paper analyze the internal and external innovation framework as follows;

Firstly, for internal technology development, R&D strategy, R&D project management and R&D organization management is necessary. Internal technology development planning aligned with the technology strategy such as technology roadmap, technology tree is needed. Also, the efficient R&D project management such as stage-gate process, CCPM(Critical Chain Project Management) is needed. R&D organization management such as R&D HRM, R&D performance management system considering the characteristics of R&D professionals also, should be established.

Secondly, for utilizing the external technological resources, the capability for technology adoption, collaborative research, strategic alliance should be secured[3,13]. For the adoption of external technology and

cooperative research, key(core)/element technology should be identified through the technology roadmap. And against the opportunistic behavior of collaborating partner, the protecting mechanism for key(core) technology should be prepared.

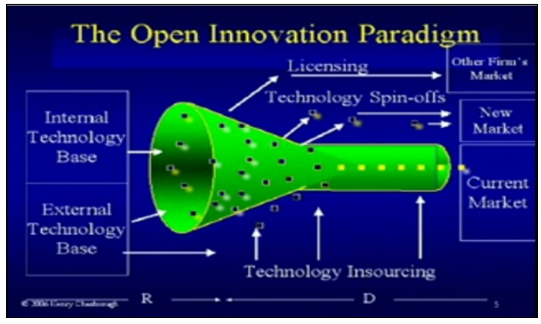


[Fig. 1] Balancing the internal technology development and utilization of external technology resources, Source: Revised from the framework for technology management, J.T.Bae(2006), [19].

4. The Growing importance of Industry–Academia Cooperation in Technology Management field

In addition to the internal technological innovation, there is a growing importance of utilizing technological resources outside the organization nowadays. From the linear theory of innovation, to chain-linked model and the social innovation and user innovation model, now the innovation theory combines the perspective of networking. In linear model of innovation, so called, pipe line model, innovation occurs from basic, applied, manufacturing in sequence. The more the input existed, the more innovation can be anticipated[3,7,13]. In chain-linked innovation model, the concept of product can be determined by the collaboration of the R&D and market, and planning, test, manufacturing occurs from the collaboration among the R&D, market and various innovation actors[17]. From the interaction among the innovation actors, the diffusion of the information, knowledge can be anticipated[3,7,13]. In addition to the chain-linked innovation model, the concept of social innovation and user innovation are emphasized nowadays. The social innovation focus on the solving the problems of the society and the use innovation focus on the solving the needs of various users[18].

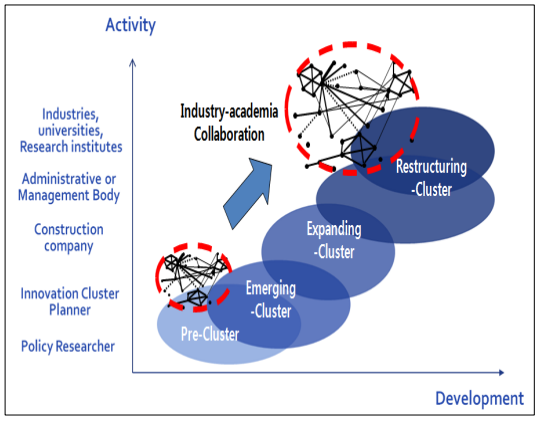
With the advent of these new innovation theory, the open innovation paradigm is emphasized nowadays. In open innovation theory, firms inevitably should have to collaborate the external innovation actors and utilize the external technological resources in addition to internal technological innovation[14, 15, 16]. Nowadays R&D professionals can move freely and with venture capital support, these professionals easily create venture, so open innovation paradigm is approached[14, 15, 16]. In open innovation, in addition to internal technology base, external technology base is equally important for the survival of the organization[14-16].



[Fig. 2] Open Innovation Framework : Internal and External Technology Base, Source: Open Innovation(Chesbrough, 2003) [16].

With open innovation theory, nowadays, cluster theory is much more emphasized. This cluster theory has a implication for S&T policy and regional policy. Basically, cluster is the connected network of various innovation actors such as university, research institute, firm and venture capital etc[25,26]. In cluster, innovation actors compete and collaborate within and outside the cluster[25,26]. Among various forms of cluster, particularly, the cluster for R&D is, so called, the innovation cluster[20,21]. Innovation cluster develops through the stages from the pre-cluster, emerging cluster, expanding cluster, restructuring cluster[22,23]. At the initial stage, the speed of the development seems to slow, however, when it approached to expanding cluster stage, the formation of networking among innovation actors, grows very rapidly[22, 23]. With the development of the cluster, the formation of network among firm, research

institute and university - so called, industry-academia collaboration - is activated 'in' and 'around' the cluster.



[Fig. 3] The developmental stage of innovation cluster and industry-academia collaboration, Source: D.S.Lim.(2008), The operational strategy of the Gwanggyo Technovalley, GRI, Picture modified.

Through the networking among the innovation actors, ideas, information and capability can be exchanged. This novel recombination can produce the new innovation. By utilizing this innovation, firm can expedite the innovation process, and can make new innovative product[13].

Because of the importance of the networking in and outside cluster, networking policy is emphasized. The industry-academia collaboration policy is the one of the networking policy[13]. Various form of industry-academia collaboration occurs in innovation cluster such as industry-industry, industry-academia and industry-university[13]. The purpose of the industry-academia collaboration is for the research, technology development, technology transfer, human resources training, information exchange, technology commercialization and marketing. Because of the diverse forms of collaboration and various form of the purpose, OECD refer to networking in cluster as the tip of an iceberg in ocean[24].

5. The Technology Management Strategy for Industry-Academia Cooperation

With the paradigm of open innovation, successful technological innovation companies should have a technology management strategy for utilizing external technological resources, and combine its resources with internal technology development capability. This technology management strategy is industry-academia collaboration strategy. This paper approached this technology management strategy in 3 ways. That strategy is summarized as follows;

The first is formulating the technology strategy considering the open innovation by utilizing the strategic technology roadmap. The second is establishing the open innovation system. The third is activating the networking with various innovation actors.

5.1 Formulating the Technology Strategy considering the Open Innovation by Utilizing the Strategic Technology Roadmap

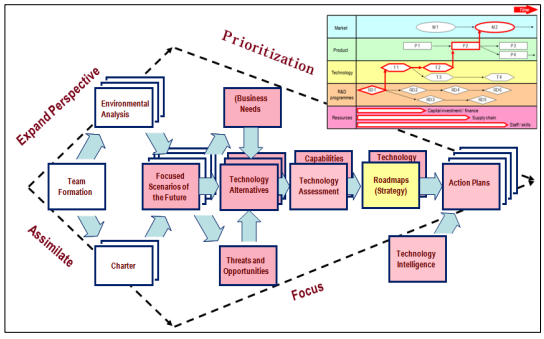
Due to the paradigm change of innovation toward open oriented for the survival of the firm, there is a need to formulating the technology strategy considering the open innovation. In addition to the alignment of technology strategy with the competitive strategy and business strategy, the technology strategy should be the framework of integrating internal technology development and external collaboration direction.

When formulating the technology strategy such as technology intelligence, technology choice, technology development timing, considering the external collaboration perspective is very important. In this reason industry-academia collaboration strategy in firm is very important function of the technology strategy.

After making the technology strategy framework considering the open innovation, this should be organically connected with the R&D execution system. Particularly, through the implementation and utilization of technology roadmap, the opportunity for external collaboration can be explored. Technology roadmp contains all kinds of information regarding the market trends, product information, technology information, R&D resources, internal capability for R&D[11]. The roadmap used in the firm organization can be called the strategic technology roadmap. The utilization of technology roadmap can contribute the performance and innovativenss of the product[27].

For the effective industry-academia collaboration, implementation and utilization of technology roadmap in

organization can be very important. Because it can provide the information not only for internal development and but also, for the external collaboration guidance for all innovation related function in organization.



[Fig. 4] Formulating the Technology Strategy considering the Open Innovation by Utilizing the Strategic Technology Roadmap, SRI(2001), Applying Scenarios to Enhance a Technology Strategy, Technology Management Part Revised, [27]

5.2 Establishing the Open Innovation System

The second strategy is transforming the technology management system to 'real' open innovation system. For execution of technology strategy considering the open innovation environment, the R&D system, operating routine should be changed to open innovation system. Many companies know the importance of the open innovation system, however, there is little effort to adopt and implement of that system in organization. For the successful adoption of open innovation system, top management support, change of internal system and building the open R&D culture can be the critical factors.

Firstly, the top management support for the open innovation can be as follows; setting the new vision, supplying the industry-academy collaboration incentive, providing the information regarding the collaboration. Through these kinds of support from the top management, all employee can recognize the importance of open innovation.

Secondly, for the successful implementation of open innovation system, the old system, operation routine and regulation should be completely changed. Former R&D outsourcing procedure and collaboration regulation suited for closed innovation system, can be the restriction for adopting the open innovation. It is only after the abolishing the closed style regulation that organization can successfully adopt and implement the open innovation system.

Thirdly, in addition to the procedure and regulation change, the culture should be changed to an open innovation culture.

When the strategic change is needed, the culture can be the invisible barrier to that change. Particularly, in R&D organization, there can be a NIH(Not-Invented Syndrome[28]. NIH syndrome can exist from the R&D planning, R&D project implementation and commercialization process[28]. It is only after the overcoming the NIH syndrome that open innovation culture can be established. For the R&D performance and knowledge sharing of R&D professionals, open innovation culture should be established.

5.3 Activating the networking with various innovation actors

Final strategy is activating the networking with various innovation actors such as firm, research institute and university. For activating it, the support system for networking should prepared in organization[13]. The form of industry-academia collaboration can be industry-university collaboration, industry-research collaboration and industry-industry collaboration. Another form of collaboration can be seen as per the strategic position of firm and firm size.

For an easy collaboration, networking support system should be prepared in an organization. The strategy division can take the responsibility of it.

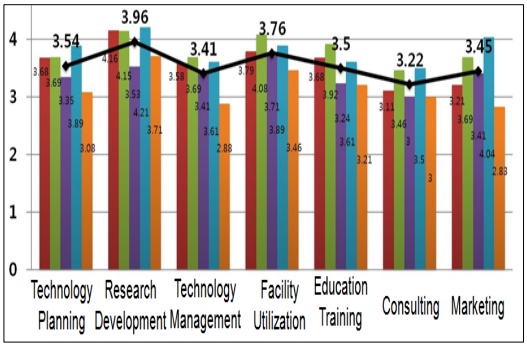
Collaboration for R&D and technology development can be co-research, R&D outsourcing, and to do this, regional technology development program and related information should be shared in an organization.

Collaboration for education and training can be the customized education, job-training, re-education, internship and to do this, information and support program should be provided for R&D professionals.

Collaboration for manufacturing, technology support can be technology transfer, problem-solving in specific technology, shared facility support, and to do this, related information should be supplied for an R&D professionals.

It is only after the establishing the support system for

activating the networking with external innovation actors that organization can actively participate in the industry-academia collaboration activity in innovation cluster.



[Fig. 5] Example Picture of Various Purpose of the Industry-Academia Cooperation from Technology Planning to Marketing, Source: W.I.Lee(2012), The study on the Cluster Analysis for Activating Innovation Cluster, Korea Journal for Academia-Industrial Cooperation Society Vol. 13 No 8, pp 3477-3485, 2012 [29].

6. Conclusion

This paper studies the technology management strategy for activating the industry-academia collaboration. Technology management framework was analyzed internally and externally. For the successful technology management, CEO should balance the internal technology development and the utilization of the external technology resources, and collaborating with other innovation actors such as firm, research institutes, and university. Companies now face the open innovation paradigm, and this paper see the open innovation, innovation cluster and industry-academia collaboration.

With the advent of the open innovation paradigm, for the successful technology management, firms should take the technology management strategy in 3 ways.

The first strategy is formulating the technology strategy considering the open innovation by utilizing the strategic technology roadmap.

The second strategy is establishing the open innovation system overcoming the NIH(Not-Invented Sydrome).

The final strategy is activating the networking with various innovation actors such as firm, university and research institute.

In spite of growing importance of open innovation and innovation cluster, there are not many researches regarding the technology management strategy for industry-academia collaboration in the firm.

This paper present technology management framework for balancing the internal technological capability and utilization of external the technological capability, and collaborating with the external innovation actors. Also, for the survival of the company in hypercompetion, this paper suggest the technology management strategy for industry-academia collaboration in 3 ways. Based on the framework and strategy presented in this paper, the success factors and determinants for the survival of company in open innovation environment can be studied in the future.

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<Research Interests>
Technology Strategy, R&D Organization Management, Industry-Academia Collaboration, Innovation Cluster