Key Factors for the Linkage Strategy between R&D and Commercialization for Gen-Ⅳ

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1. Introduction

A nuclear energy industry, a technology and capital-intensive industry, has considerably contributed to energy security in Korea. However, the Fukushima nuclear disaster has leaded to enhance the safety and the cost-effectiveness of technology for the future so that advanced countries such as United Sates and France have concerned about a next generation nuclear power plant, Gen-Ⅳ(Generation-Ⅳ Reactor).

Considering various characteristics of nuclear R&D, it is necessary to have more elaborated strategies for the effective development of the next generation of nuclear technology. In this study, we suggest 5 key factors for the successful commercialization of Gen-Ⅳ by analyzing the distinct characteristics of nuclear R&D with Gen-Ⅳ and CSF(Critical Success Factor)s of several cases in these field and conducting the FGI(Focus Group Interview).

2. The Characteristic of Nuclear R&D

2.1 The characteristics of nuclear R&D projects

Nuclear technology of Korea has developed and grown to the point of constructing a self-designed nuclear power plant system based on technological catch-up by public research institutes since the 1960s that nuclear research reactor was introduced [1].

According to NTIS statistics, the average R&D expenditure of a single project of public R&D and nuclear R&D of Korea are 360 million and 790 million KRW respectively. This shows that the expenditure of nuclear R&D is almost twice as much as one of national R&D projects. Moreover, the proportion of a long-term project of national R&D is 9.1%, whereas that of nuclear R&D is two times, 19.1%, in the nuclear energy field. Accordingly, to link R&D outcome to commercialization is very important because it is usually required the enormous investment and the long term on R&D program, it is very important to link R&D output to commercialization.

2.2 The characteristics of Gen-Ⅳ R&D projects

Gen-Ⅳ is getting much attention as the next generation of nuclear power plants in that it is more resource reusable, safe, eco-friendly, and proliferation resistant than existing nuclear power plants. Moreover, Korea government announced that its development is in progress and would be commercialized by the year 2025[2].

The development of Gen-Ⅳ is a long-term challenge and needs budget more than other nuclear technologies. Especially, the majority of Gen-Ⅳ R&D projects have the task performance period – a period of an agreement of a single national R&D project - of over 5 years. Figure 1 is shown ratios of the number of R&D projects by different periods. In order to get successful linkage between the R&D outcome and its commercialization during next several decades, systematic strategies and proper actions for Gen-Ⅳ should be prepared.

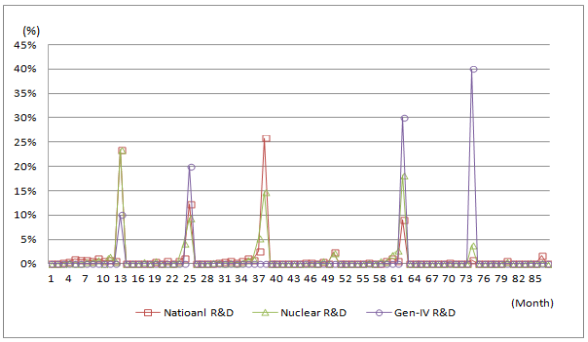

Fig. 1. The task performance periods of national, nuclear and Gen-Ⅳ R&D projects

3. Key factors for the Linkage Strategy of Gen-Ⅳ

CSFs are key elements for successful competitive performance and satisfactory results in the individual, government department or organization. Its concept is defined by D. Ronald and McKinsey & Company in 1961, and John F. Rockart developed them based on five different fields, the industry, the competitive strategy, the environmental factors, the temporal factors and the managerial position, in 1979 and 1981[3]. CSFs, one of methodologies for strategies, are used to achieve their goals effectively by many researchers until now.

3.1 National R&D programs and CSFs

Many researchers have been aware of the difficulties of the linkage between R&D results and commercialization and studied these factors in order to solve problems. We have analyzed several cases and categorized them into five factors from CSFs.

O. Kimura found several major factors from both public R&D and its commercialization of energy-efficient technology of NEDO(Case 1)[4], and Baer

suggested some factors of demonstration projects which are federally funded successfully[5]. Also, K. Hwang researched key factors for the strategy and system to support and strengthen R&D and the policy measures to commercialize marine energy (Case 2)[6], and T. Kim studied factors of public R&D that can influence on commercialization[7]. These suggested factors by cases can be evenly categorized according to five fields from CSFs. The results are summarized in Table 1.

Table I: The categorized factors of two representative cases

	Case 1	Case 2
Industry	Enhancement of private R&D	R&D based on market demands
Competitive Strategy	Proper diffusion strategy	Encouragement of cooperation
Environmental Factors	Reflection of the changing meaning of high value (e.g., innovativeness, environmental safety)	Leading the international initiative for intensified competition
Temporal Factors	Long-term projects	Long-term projects and stable funding
Managerial Position	Supportive policy (e.g., investment subsidy)	Expansion of incentive policy

3.2 Korean nuclear R&D programs and CSFs

In Korea, there were two representative R&D programs for commercial nuclear power plants, Advanced Power Reactor-1400(APR1400) and System-integrated Modular Advanced ReacTor(SMART). APR1400 has earned a positive reputation as a good example that links R&D outcome to commercialization, whereas SMART did not have any follow-up plans such as interdepartmental agreement between the MEST(Ministry of Education and Science Technology) and MKE(Ministry of Knowledge Economy) for commercialization after SDA(Standard Design Approval).

Table 2: A comparison between APR1400 and SMART

	APR1400	SMART
Industry	KEPCO participation	No participation from industries
Competitive Strategy	Consistent plans (K-NGR project)	Several changes of program plans
Environmental Factors	Technology advancement for energy supply stability	Needs for export competitiveness and safety assurance
Temporal Factors	10 years (`92~`01)	17 years (`97~present)
Managerial Position	Export policy and operator as KHNP	No operators and follow-up plans

Gen-Ⅳ is expected to have same problems that SMART had because both of them use a similar development model. Unlike APR1400 that was the catch-up technology, they need a life-cycle plan for the technology development from the design, the construction, and the operation to the regulation. In this regard, SMART should have been developed from fundamental technologies to commercialization, and this is the reason that SMART was hard to get the participation from industries, the consistent strategies and the linkage between relevant ministries. This shows that it is necessary to establish the proper strategy of R&D and commercialization for Gen-Ⅳ.

3. Conclusions

Considering these results, we could find and suggest some important points for further strategy for Gen-Ⅳ. That is, following five key factors for the linkage improvement between R&D and commercialization of Gen-Ⅳ should be considered: (1) the participation of nuclear power plant operators from the beginning, (2) the establishment of consistent and comprehensive plan/roadmap/detailed strategy, (3) the technology development based on global energy issues and international cooperation, (4) the stable and clear funding plans for long-term projects, (5) the cooperation of relative ministries.

Gen-Ⅳ system is getting a positive response in that it accompanies long-term R&D plans in Korea. We think that the standard of Gen-Ⅳ would lead the next generation of nuclear industry if the proper strategy for the cooperation between the private sector and the regulation from the beginning. Moreover, we expect that this study will facilitate its development process from R&D to commercialization.

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