A Brief Comparative Study on R&D Collaboration Strategy in US and French nuclear utilities

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1. Introduction

KHNP, Korea's only one monopolistic public nuclear power utility, has been actively pushing R&D strategy to promote localization of core technologies using so called "In-house R&D management". So far KHNP's R&D strategy has been evaluated as 2.5th generation R&D management and R&D investments are focused to the key technologies such as Korea's own nuclear reactor design(like APR1400) development, engineering gap lists elimination(plants trouble shooting), construction/operation process enhancement, etc. But when we compare our R&D strategy with US and France utilities, we can find a lot of differences and the need of improvement to accelerate overseas export of nuclear power plants(technologies) and to be a world top class nuclear operator. One of prominent difference is R&D collaboration strategy.

The definition of R&D collaboration has evolved over the years, but for this paper I use it to mean the process where multiple parts of an organization or stakeholder work together toward a set of common goals. And by co-funding or cost sharing, collaborative R&D can reduces financial and technical risk and encourages knowledge exchange, supply chain development and in return, collaborative R&D can produce more advanced, complex, effective, efficient R&D products in relatively short time with relatively less budget.

UK's technology strategy board estimated that "Each £1 we invest in collaborative R&D typically returns around £7 in GVA(Gross Value Added)."

In this regards, this paper will cover briefly the benefits of collaboration R&D strategy which is widely used in US utilities and French EDF.

Utility	Annual Sales (KRW)	R&D Budget (KRW)	Employees	
			All	Nuclear
Exelon	~24 trillion	~21 billion (0.09%)	~26,000	~11,000
EDF	~100 trillion	~727 billion (0.73%)	~107,500	~25,000
KHNP	~6.6 trillion	~150 billion (2.2%)	~9,603	~8,819

Table 1. Three major nuclear utility overview

2. Collaborative R&D Case Study in US and France

2.1 US Utilities (EPRI Consortium Case)

The deregulation of the electricity sector in the US began with the Energy Policy Act of 1992. And in the last quarter century, the deregulation of electricity market has brought significant R&D expenditure reduction (over 40%) in US utilities. With sharp declined R&D investments, US utilities have been introducing various of operational innovations or restructuring such as License Renewal, Power Uprates, Risk Informed and Performance Based Regulation and Operational Strategies to survive in deregulated electricity market. The competitive market environments have changed US utilities' R&D expenditure pattern. The combined R&D spending of the 112 largest operating utilities, which perform more than 93% of all non-federal utility R&D, was $778 million in 1993 but has dropped to $486 million by 1996. (1997 dollars) [GAO 1996]

In 2012, Exelon, the biggest nuclear utility in US, spent only $20.5 million (0.09% of total sales) to R&D sector and almost all of this money went to EPRI membership fee.

With consent within US government, US utilities altogether established a collaborative R&D consortium, the Electric Power Research Institute (EPRI) in 1972 to conduct and coordinate R&D on behalf of electric utilities. And the utilities just participated in EPRI programs individually to set up utilities' R&D priorities(R&D gap lists) through their consortia efforts and sometimes as hosts of joint projects. [1]

Chauncey Starr, the founder of EPRI, established EPRI as the first industry wide "Virtual R&D organization". The main driving force was virtual R&D institute's flexibility and speed with limited budget.

From 1983, the term "virtual R&D environment" was used by some of corporate R&D managers with the definition of "internal research strategy with external scientific centers based in academia and government laboratories". [2]

The EPRI's virtual R&D model means the inner employees do not conduct research by themselves, but they identify and prioritize the industry's R&D gaps(industry's operational or strategic problem list)

with utility members' participation. With outside research network and resources EPRI organize the gap-solving projects and they manage the projects using collaboration R&D mechanism.

Therefore the main competencies of EPRI staff is not the research ability, but industry-wide insight to catch member utilities' R&D gap and the ability to manage the outside resources, to communicate with stakeholders, to manage the collaboration projects.

EPRI's key collaborative organizations include all US nuclear utilities, INPO(Institute of Nuclear Power Operations), NEI(Nuclear Energy Institute), NRC, DOE(Department of Energy) and all nuclear-related national laboratories, universities and industry vendors, small engineering firms, and their numbers exceed 1,000 energy organizations. Most of these collaborative partners bear their shares with cost sharing method when they participate in one of EPRI project.

EPRI nuclear sector's recent annual budget was around $140 million(very similar to KHNP CRI annual budget), but with this limited budget, EPRI nuclear sector produced average 300 of R&D output deliverables annually(In case of KHNP CRI 40~50 deliverables annual). We can assume that the averaged budget for one deliverable is $0.47 million. (한화 약 5 억원)

This small investment per output would not be achievable without cost-sharing with collaboration R&D strategy. [3][4]

Utility R&D Org.	Utility R&D Employees	Annual R&D Outputs	Main Mission
EPRI	180	~300	Operation Gap Elimination
EDF R&D	2100	~500	Future and Overseas Business Development
KHNP CRI	350	~50	Base Line Technology Development

Table 2. Three major nuclear utility R&D status

2.2 France (EDF Case)

Unlike the US private owned utilities who has been struggling to survive in deregulated electricity market, French government-backed a limited company EDF has been investing R&D division actively and uniquely for all EDF businesses (generation, customers and sales, electrical network, energy management, renewable energies, IT and simulation).

In short, EDF R&D with 2,100 employees lead nation-wide nuclear R&D related to next-generation nuclear power plant design, engineering gap, construction/operation process enhancement like KHNP CRI, but EDF R&D include more future-oriented technology development connected to all business sectors with their in-house engineering organizations consist of more than 4,700 staffs.

Especially from 1990s when the EU and global market opened, EDF has been achieving huge growth of global export of their technologies. During the international expansion of EDF, EDF R&D sustained unique roles from information gathering for market demand to prepare demand-driven future technologies development, to new energy services invention, to strengthening EDF's competitiveness in the global market, etc.

For this diverse global mission, the EDF R&D have established 9 international R&D centers (3 in France, German, Poland, UK, China, Italy, US with EPRI membership) and collaborated with 14 shared research laboratories, 320 partnerships with universities, research institutes and academic institutions in France, 74 partner projects with EU with 16 joint technology initiatives, many research projects with international leading energy players and renowned institute and universities.

EDF R&D also applied open innovation. A team of 20 staffs operate R&D open innovation. They are identifying and monitoring over 800 innovative ideas within 3 years using network spread across 3 continents (Americas/Asia/Europe).

The annual budget of 2012 EDF R&D was € 518 million, and around 70% went to the activities directly supporting group business, the rest of 30% to anticipation and preparation for the future.

EDF R&D produced average 500 of major R&D output annually. We can assume that the averaged budget for one project is € 1.04 million. (한화 약 14.5 억원) [5][6][7][8]

This relatively small investment per output could be achievable with dynamic domestic and global collaborations with cost-sharing and open innovation.

Utility R&D Org.	Research Division	Projects[1] /Person	Budget /Person (KRW)	Budget /Project (KRW)
EPRI	10 Major Programs	~ 1.7	~830 million	~500 million
EDF R&D	15 Departments	~ 0.2	~350 million	~1,450 million
KHNP CRI	28 Groups	~ 0.1	~430 million	~3,000 million

Table 3. Three major utility R&D productivity status

[1]. Projects means "annually finished R&D outputs" or "deliverables". From this index, we can assume organization's R&D productivity in part.

3. Conclusions

Even though the US and French utilities were placed in different business environments and technology development strategy, but they had common R&D strategy to promote their R&D productivity and effectiveness. They both have been using open innovation and collaborative R&D with co-funding system.
The benefits of those two countries' R&D collaboration strategy can be summarized like below ;

1. Quantitative aspects
① R&D productivity(Annual R&D output/deliverable) increase
② Cost Sharing or co-funding with collaborative stakeholders can reduce the cost of R&D per project dramatically
③ Average R&D lead time and project period can be reduced
④ Multiplication Effects : One project can produce several ouputs simultaneously for all collaborative stakeholders
- Outputs for utility, regulatory agencies, relevant industries, universities (Plus Human Resource Education), National Labs.

2. Qualitative aspects
⑤ Final outputs' effectiveness will increase due to stakeholders' participation with co-funding and responsibility
⑥ High end quality can be achieved due to the outside cooperation with intentionally chosen as a global benchmarking/standard
⑦ Utility can strengthen the technology network system for open innovation

Compared with KHNP, R&D collaboration study suggests the need to improve the existing R&D strategy of KHNP clearly. But for more in-depth study we must deeply evaluate in advance the difference of Corporate mission/strategy, market environments, the base line technology status and the quantitative and qualitative differences in the maturity of the relevant research resources(including national lab., vendor industries and various expertise engineering firms) for domestic collaboration. The maturity of the relevant research resources need time especially for small expertise engineering firms. And there are various systematic and cultural barriers to apply the collaboration R&D.

REFERENCES

[1] Linda Cohen, Paroma Sanyal, R&D Choice in Restructured Industries : In-house v/s Collaborative Research in US Electricity Industry, 2008
[2] Debra M Amidon, The Challenge of Fifth Generation R&D, Research Technology Management Vol 39 No.4, 1996
[3] Miguel Castro, Roger Foster, Kevin Gunn, Edward Roberts, Managing R&D Alliances Within Government : The Virtual Agency Concept, IEEE Transactions on Engineering Management Vol 50 No3, 2003
[4] John Holdren, Federal Energy R&D for the Challenges of the 21st Century, Chapter 2(The Role of R&D and the Changing R&D Paradigm), Report to US President, 1997
[5] EDF, 2013 Facts & Figures, EDF Website, 2013
[6] Nikola Novakovic, etc, EDF v/s RWE, IIM/EURO MBA Studies, 2005
[7] EDF, EDF R&D Rising To The World Energy Challenges, EDF Website, 2012
[8] Bernard Salha, EDF R&D, Roundtable on Scientific Support for European Industrial Competitiveness, 2012