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A Study on the Revitalization of High Performance Computing in Korea☆

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ABSTRACT

Crucial aspects to successfully realizing the re-emergence of a contemporary and sustainable supercomputing community in South Korea will involve the devoted efforts and support from key government and R&D organizations. We suggest various supplementation plans regarding the roles of support for the statutory plan. This includes the committee and the plans which are often missing necessary support systems that help competent ministries to plan properly according to the missions of the research center. This dissertation suggests that adjustment in the HPC trends will depend upon exposing and correcting problems in the law as well as overall improvement of the law. Also, the total development of a super computing market is necessary. The results of these guidelines will create a spread of demand for supercomputing for national IT resource sharing, and will foster the development of supercomputer specialists worldwide. Other major end results include significant increases in research productivity and increased rates of product development.

☞ keyword : High Performance Computing, Utilization of Supercomputing, revitalizing of Supercomputing, Amendment, Supercomputing Ecosystem

1. Introduction

1.1 Background and Needs

Based on acknowledgment of securing national competitiveness for science technology, desperate needs for fostering supercomputers with enacting the relevant act have been brought up by various R&D researchers. As a result of recognizing the changing environment, the devoted efforts from government and relevant R&D research centers are needed to materialize the needs and goals of enacting the Act.

The purpose of Act on Utilization of Supercomputers is to establish main strategy and raise the level of utilization equal to developed countries for fostering the utilization of supercomputers and embracing super-computing competency more efficiently.

And this Act is to lead the social changes and clearly stipulate appropriate measures for promoting the public interests leading innovative R&D technology and set the trend for environment changes.

After enacted the law in 2011, the important business planes are not specified and planned because of the pending issues like establishment of national and tier1 center, building the system of raising manpower, building shared resources utilization system as national level.

1.2 Overseas political trends

The U.S. has enacted number of Acts including High Performance Computing Revival Act of 2004, The Most Advanced Computing Revival Act of 2004(DoE). The U.S. has been fostering super-computing by establishing Networking and Information Technology Research and Development and executing the relevant Acts to develop science technology, to secure national security, to improve

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national competitiveness and industrial productivity. Its goal pursues sustainable economic growth, to promote people's health, to protect the environment, and to improve the quality of people's life.

The Council on Competitiveness (COC) of the U.S. has selected super-computing to secure the national competitiveness and emphasize it as follows; "Securing competency in supercomputing is the important factor to compete with other countries."

In Japan, they have been developed high performance computer strategically based on the Science and Technology Policy Act at the national level since the late 1980s. They announce the "Science and Technology Basic Plan" for every five year. MEXT is responsible for Japan's National high performance computer project and affiliated research institutes of MEXT like AIST (Agency of Industrial Science and Technology), GTRC (Grid Technology Research Center), and RICS (Computing Science Research Center) are performing actually

In the "3rd Science and Technology Basic Plan (2006-2010)", four areas such as life sciences, ICT, environment, Nano materials are specified as high priority development areas. Particularly, the development of next generation high performance computers in the ICT sector technology is considered to be strategic focus. In the 4th Science and Technology Basic Plan, Japan pushes ahead development of exa-scale high performance computer. Several projects like NAREGI (National Research Grid Initiative), ITBL are performed to develop middleware, software for high performance computing applications.

EU also has announced high performance computing (HPC) plans to become the leader in high-performance computing. EU is pursuing cooperative researching with the member countries to develop high performance computer related technologies and to get research funds. Each country is also promoting its own researching at the same time. In 2000, EU has defined "European Research Area" based on Lisbon strategy and pursued cooperative researching with EU as a central.

For example, PRACE (Partnership for Advanced Computing in Europe) is a 20 European Union countries project to develop the Peta Flops system technologies and extend the technologies to exa-scale computing system development by 2019.

DEISA (Distributed European Infrastructure for Supercomputing Application) is a 11 European Union countries project aiming to build science and technology, high performance computing infrastructure applications, supporting a 280 billion won (2.8 billion won a year) in research by 2011

EESI (European Exa-scale Software Initiative) is that EC organized the program consists of 25 European partners aiming to set an exa-scale software roadmap and funds about 10 billion won by 2011.

TEXT(Towards exa-scale Application) organized by the European Commission, aiming at possible practical parallel programming models applicable to exa-scale development period, the grant will support a total of 50 billion won.

China has world class high performance computer technology due to a long-term investment based on National science and technology policy. They have executed 863, 973 and cloud plan to promote high-performance computing technology development, 973 plans. "China's long-term science and technology plan" say modernization strategy through technological innovation. China also invests over trillions won for that. Chinese conducts national high performance computer projects and the each sub-project is carried out in NHPCC (National High Performance Computing Center), ICT (Institute of Computing Technology), and NCIC (National Committee for intelligence Coordination)

2. Principal contents of the act

2.1 Outline of the act and Principal contents of the act

The Act proposed to the National Assembly in 2009 contains the essential points including establishment of super-computing environment, technology development, development of computing manpower. And the act covers establishment of national level ecosystem for utilization of super-computing establishment of national plan. This Act defines development, introduction, operation, management and utilization of supercomputing as a national level including production, process, execution, and utilization of large scale data. Therefore, this Act contains the concept of national informatization in a broad sense including utilization of

software as well as infra environment.

In the section of promotion system, the matters regarding fundamental, execution plan, and implementation system together with establishment, designation of the promotion system including the National Super-computing Committee, Super-computing centers are defined. By establishing national Super-computing centers, the Act lets these centers play roles as main agents to establish ecosystem for super-computing and to foster utilization while it stipulates to increase number of governmental bodies utilizing super-computers, and to establish infrastructure for the relevant promotion policies.

In the construction of infrastructure, the matters with regards to fostering infrastructure for super-computing is stipulated while matters regarding

2.2 Proceedings for enactment of the act

The stages for enacting the Act can be mainly classified into 4 stages. The summary of contents conducted for each stage is as follows.

- **1st Stage: Request and review (2004 ~ 2008)**

The needs for the Act are brought up and status analysis is conducted at first stage

- Parliamentary inspection of the State Affairs Committee (250th regular session), urged “study for legal and systematic measures for vitalizing national super-computing
- Parliamentary inspection of the Science, Technology, Information, and Telecommunication Committee (256th regular session), urged “study for efficient utilization measures for domestic super-computers”

- **2nd Stage: Planning for enactment (2007 ~ 2009)**

Planning is conducted for enactment after the needs and feasibility is acknowledged at the second stage

- KISTI conducted “research on promotion strategy for national super-computing
- Founded “Computational Science and Engineering” with 200 initiators

- **3rd Stage: Enacting the act (2009)**

The third stage where proposal of the Act is put forward

<table 1> Building the High performance computing environment of US-class

Items	U.S.A	Korea	note
Act	•High Performance Computing Act - ALBERT ARNOLD GORE JR.	• Korean HPC act - Jeong Dueon, a member of congress	'09.09.15 proposal
Master Plan	•Federal Plan for High-End Computing	• Master plan for national high performance computing upbringing	Article 5
Decision making	• National Science and Technology Council's Committee o n Technology	• National High performance computing communities	Article 7
Administrative organization	•The Subcommittee on Networking and Information Techn ology Research and Development	• IT integrated research development manager	
Executive organization	•The National Center for Supercomputing Applications	• National Supercomputing center Establishment	Article 9
Member	•The main sectoral national centers -National and public universities and research institutions	• National center establishment - By expertise - By special-purpose - By region	Article 9
Related business (budget)	•NITRD Program(4,260.7 million dollar)	• National R&D project	Article 10, 16
Goal	World Top 1	World Top 5	Article 11

a motion to the National Assembly and action for enacting the Act is taken.

- Education, Science and Technology Committee (ESTC) reviewed and promoted demand and need for enactment of the Act (Assemblyman Doo-Eon JUNG)
- Put forward a motion and received at the 284th regular session of the National assembly

※ Bill number 1806033 (2010 ~ 2011)

- Expert committee of ESTC of National Assembly submitted the review report on the Act
- Public hearing of the bill was held
- ESTC of National Assembly laid the bill to the first law review subcommittee at the 298th provisional session of the National Assembly
- The Legislation-Judiciary Committee approved the Act at the fourth plenary session of the 299th National Assembly (modified and then approved)
- Enacting and Implementing Act on Utilization and Fostering of National Super-computers

※ Act #10770 (2011)

- Ministry of Government Legislation gathered opinions from relevant authorities, and reviewed regulation of the enforcement ordinance and related statistics
- Enacted the enforcement ordinance and the Act went into effect

- **4th Stage: Implementation (2012 ~ 2013)**

The fourth stage, preparation for implementation is conducted after the enactment of the Act.

- Established master plan for Enacting and Implementing Act on Utilization and Fostering of National Super-computers
- Enacted the enforcement regulations of Enacting and Implementing Act on Utilization and Fostering of National Super-computers.

2.3. Strategy for implementation of the act

2.3.1. System implementation

The main roles of National Super-computing Committee are defined as below.

- Establishing major policies and adjustment of the implementation with regards to establishment and modification of the framework
- Matters regarding expansion of budget for National Super-computing
- Matters regarding introduction and distribution of resources for National Super-computing
- Matters regarding shared utilization of National Super-computing resources
- Establishing and adjusting implementation of major policies and guidelines for human resources utilization with regards to master plan on human resource development and exchanges in the field of National Supercomputing
- Matters regarding maintenance, repair, and practical use of advanced network. Establishing plans for utilization and preservation of National Supercomputing R&D results, and adjustment of implementation

In order to execute important matters stipulated in the Act, a designated team shall be operated in the Ministry of Science, ICT and Future Planning as a main authority for the Act. Its major duties include operation of various committees, establishment and conducting plans, support and management of operation organization, and management of super-computing promotion related projects while it shall be operated and cooperate with the national centers established.

Professional centers can be important elements of national super-computing ecology while it is required national centers and professional centers to cooperate each other, and their functions shall be separated.

Vitalization of super-computing shall be conducted with as being total service provider for resolving resources and pending issues while professional centers shall be designated by special purpose, expertise, and region by integrating related organizations with centers.

2.3.2. Construction plan

For Construction of plan, expert meeting for master plan on relevant application fields shall be structured to prepare the plan. Experts from super-computing center shall support expert meeting for master.

MEST (Ministry of Education, Science and Technology) shall decide implementation plan for each year and guidelines for performance report, and shall report to NSTC (National Science & Technology Council) and NIC (National Informatization Committee) with summary of implementation

plan and the performance results.

2.3.3. Infrastructure

Infrastructure for supercomputing shall be managed at a national level. Development of super-computing based technology, application software, technology for processing, utilization of big data, integration between supercomputers and large-scale facilities shall be conducted in promoting technology development as intangible resources.

2.3.4. Promoting utilization

In the R&D sector, which have been promoted as base business by government funded institutes in science technology, shall be expanded to projects while R&D program shall be adjusted in a way that professional centers can conduct the projects.

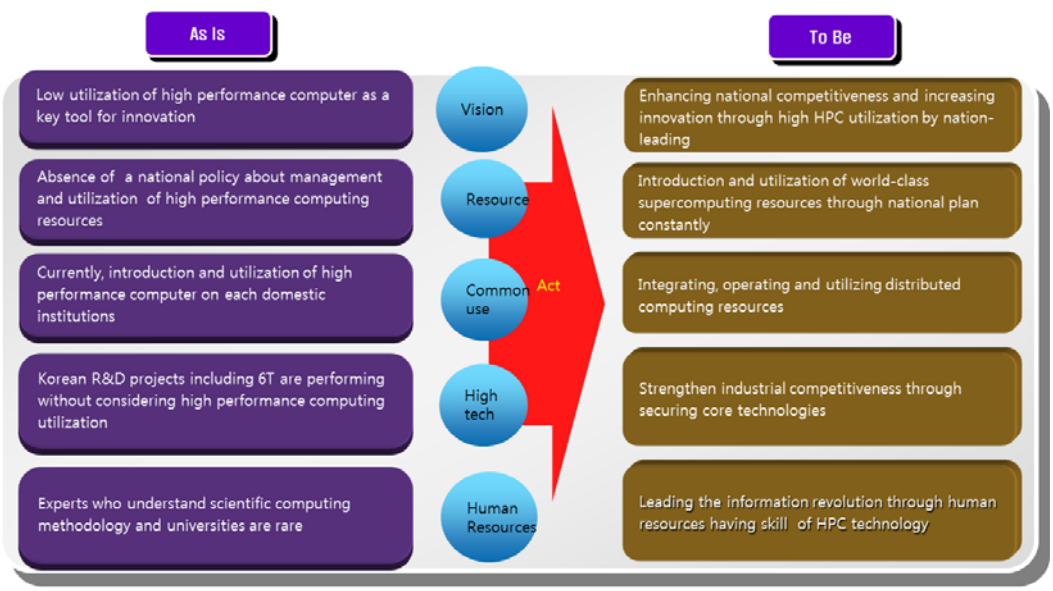
For industrial applications, utilization of super-computing in industrial technology and development of relevant technology shall be vitalized and promoted, while practicality of super-computers shall combine with technology oriented small /startup companies to secure technology competitiveness and to promote commercialization. Through industrial application business, industrial competitiveness can be increased by innovation of system and providing high performance computing competencies to next growth generation energy in order for traditional industry including automobile, ship building to secure sustainable competitiveness.

3. Status of Law Enactment

After enacted, the law could not be properly promoted the matters prescribed in the law due to no right department. The department to lead the future should create the new blue ocean with science and information technology fusion. In order to achieve this goal, MIPS should specify supercomputing application areas like AI, Big data, Bio technology, disaster control, to focus areas for department. The principal agent needed to push forward with the law in the competent ministries (for instance MSIP, ROK).

Because national supercomputing center is in a state of less powerful leader as national agency, we need ensure the independence of national supercomputing center management and the National supercomputing center independency because the institutes designated as a national center to perform supercomputing utilization and ecosystem service.

After enacted the law in 2011, the important business planes are not specified and planned because of the pending issues like establishment of national and tier1 center, building the



<figure 1> Improvement direction of the law

system of raising manpower, building shared resources utilization system as national level. We just have done the feasibility study for introducing and operating supercomputing system, developing system by ourselves.

4. Proposal to amend the law

4.1. Supercomputing governance areas

Comparing at the time of legislation, the field of supercomputing needs such as secure areas, culture, agriculture, forestry and fisheries are expanding. We need to expand the roles and scopes of the participating departments related to the law with details on compliance of supercomputing promotion.

There is also missing part about establishing relationship for building supercomputing ecosystem between national center and tier1 centers among the national center missions. We should make a regulation about tier1 centers nomination as national center role for building supercomputing ecosystem.

We also suggest that supplement the roles about supporting part of the statutory plan such as national committee and basic plan because of missing the supporting system that help competent ministries to plan the basic planning among the national center missions.

4.2. The areas related establishing Supercomputing promotion and vitalizations

Supercomputing vitalizations project as national R&D to improve National levels R&D productivity and to enhance the efficiency of big-data Science should set up and insert and additional article for the project operation. Currently, it has become critical issue about national policies establishment for domestic HPC market development, ICT industry development and advancing HPC use. So, we need relevant regulations about Supercomputer development, introduction, operation, and stipulate government endeavor to localize supercomputer development.

And we need to supplement details regarding the establishment on the basis of management and use of large amounts data because utilizing supercomputing linked to the trend in utilization of large amount of data that is currently in progress is emerging as a critical factor than ever. In addition, we need strengthening legal support for supercomputing industry support measures because supercomputing applications promote new areas to find new jobs in new sectors an enable small and private venture business.

<table 2> Summary of main amendment needs

Division	Main contents
Adequacy of development system	- Extending participated departments - Readjustment of national center's role
Compatibility of upbringing base	- Setup the provision of evidence for starting national projects based on high performance computing utilization - Define the requirements for such as development, build, operation and management of high performance computer resources - Define the requirements for big data management and sharing related high performance computing
Development and management of high performance computer (New)	- High performance computer standard guidelines - Idle, under-utilization systems promotion and maintenance reserve - Evaluation of High performance computing - Localization of High performance computing

4.3. Details about national super- computing resources management

We need additional details for regulation that the law do not deal in detail to operating and administrating efficiency for supercomputing infrastructure having very high cost.

1. Sets the standard guidelines like Supercomputing operation management standards directive, for entire cycle ranging from the construction to retirement system
2. Details regarding the sharing of national IT resources to promote the use of under-utilized and idle, insoluble supercomputing system
3. Monitoring the operation productivity of the national centers and tire1 centers

5. Conclusion and Discussion

Supercomputing is the driving force of technological innovation and competitiveness. The administration's efforts are needed to implement the purpose and significance of the legislation.

First of all, correcting the exposed problems in the law and the improvement of the law is needed to adjust the policy trends HPC flow. Building of supercomputing ecosystem is urgent. To sort out that, we need to specify the roles of national centers and define tier1 centers.

Through this work, supercomputing for industrial demand by national IT resource sharing, supercomputer specialists upbringing and supercomputing demand responding will be spreading. It can significantly increase research productivity and reduce new product development time

Expansion of supercomputing to various fields will be creating a new industry and culture as well. Above all, the willingness of the competent ministries to promoting in this national renovation projects are highly necessary.

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