A study on strategy for invigorating utilization of HPC in industry based on business building blocks model

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Abstract: In order to invigorate utilization of high-performance computing (HPC) in industries, we have described the business building block canvas and reconsidered on HPC service model that HPC service providers would take a strategic planning to give their own abilities to small industries. And we have taken a restructuring process of the business building blocks canvas to make an innovative service strategy that HPC service organizations would adopt as their own user service model. The economic benefits of the small industries through adopting HPC services provided from the HPC service organizations effectively and efficiently have increased when the HPC service model is proportionate, targeted to the industrial present problems and introduced only when absolutely necessary. We have described two differentiated HPC service models and their achievements, and examined how effective the HPC service model of the HPC service organizations is composed to provide HPC abilities to the industry. The approach of the business building blocks canvas would help the HPC organizations to analyze and restructure the strategy.

Key Words: HPC (High Performance Computing), business building blocks model, small and medium-sized enterprises, MS&A (Modeling, Simulation & Analysis), HPC service model

1. Introduction

In today’s information technology society, industries should select information appropriate for their companies, and apply them to business processes with creative reprocess for their survival and advancement. Moreover, we are facing greater disruption and an increasing innovation pace. These are constantly combining, persistently adding new shape to our future. We are actually caught up in a very revolutionary period. It is through the fourth industrial revolution (also known as Industry 4.0),
currently being undertaken, that technology, talent, and new innovation ecosystems are emerging — building greater complexity into our final innovation offerings. Intelligent automation, technology and very huge data (big data) set of various types are fueling this new industrial revolution. And this unprecedented, exponential pace of change is increasingly reliant on the artificial intelligence (AI) technology and computing resources, which would be used to analyze the big data in real time. Especially, high-performance computing (HPC or supercomputing) is accelerating various activities for technological innovation in most enterprises [10, 17]. HPC has a strong ability of transcendental speed for calculation and data analysis. Thus, with using HPC capability, industrial engineers have tried to adopt computational methods to accomplish discovery and technological innovation in various industry fields.

Innovation in manufacturing requires the deployment of engineering simulation and modeling techniques of products but also manufacturing processes, integrating HPC in the workflow and using HPC during the whole life cycle of products [18]. Adopting HPC techniques to manufacturing processes for the products, enterprises have obtained groundbreaking economic effects on cost and time in the processes of product development and manufacturing. In other words, they have produced high-quality products with low price and fast release to the markets with engineering technologies based on supercomputing.

We are confronted with circumstances that usage and applications of HPC would have a crucial influence on national economy [3]. HPC has played a key role in making new designs for many products, for example, automobiles, aerospace, medicine, microprocessor, computers, bio-implants, golf clubs, household appliances, management processes, resource discovery, manufacturing products, financial modeling, forecast of weather and climate, animation etc. [1]. And the product design process based on HPC is usually achieved with virtual design and large-scale data modeling technologies. At the time that the scope of higher value-added business expands, it becomes more and more important for HPC to affect national innovation, productivities, and competitiveness.

Traditionally, industrial product developers have come to understand that using computational tools at the high end of the performance spectrum within various areas of disciplines can provide competitive opportunities in product design quality. Almost all large companies have adopted HPC technology into the R&D and product manufacturing processes so that they have achieved high competitiveness of their products in global market. However, small companies such as SMEs (Small and Medium-sized Enterprises) have not really engaged themselves in the computational scene. Moreover, scarcity of R&D specialists and regional differences in the employment situation are prevalent in the industry, thereby, they have missed chances to get benefits from HPC. In general, SMEs have played a pivotal role in supplying parts and manufacturing creative products. In most nations, the number of the small companies and employments in SMEs takes up over about 99% and 88% of whole companies, respectively [19]. Thus, SMEs occupy a prominent place in national economy. So, for SMEs to benefit from supercomputing, it is necessary to establish a stable and sustainable HPC service and applicable model, since SMEs themselves who lack HPC skills, R&D infrastructure, and R&D funds could not overcome the limitations to adopt HPC applications. Therefore, governmental or non-profit organizations should establish an HPC business model appropriate for conditions of the organizations.

Many HPC research organizations have studied about which service is appropriate for industrial innovation, especially for SMEs' technological advance [10, 11]. They have focused on only structuring HPC environments for HPC users including product designers from industries. Current specific ICT technologies (Cloud computing [21], Big Data [7], Additive manufacturing [9], Internet of Things [20] etc.) have taken into account to be used under HPC environments. However, there has been small number of research or plans as for total HPC service strategy for small industrial innovation. As representative cases, SHAPE (SME HPC Adoption Program in Europe) has been established by PRACE (Partnership for Advanced Computing in Europe) on top of national initiatives like in France, United Kingdom, Germany, Italy, and Netherlands [2]. NDEMC (National Digital Engineering and Manufacturing Consortium) has been performed as a U.S. Midwest pilot project by NCSA (National Center for Supercomputing Applications), U.S. Council on Competitiveness, other HPC centers, and U.S. large companies. And SME Supercomputing program also has been performed by KISTI in
These programs all are for invigorating SMEs to utilize HPC and to take economic benefits from HPC technology.

In this paper, we have studied a strategy for invigorating to effectively and efficiently utilize the HPC technology in small industries (SMEs). The ultimate goal of the strategy is for SMEs to achieve economic breakthroughs through the technology innovation. The strategy has been designed on the basis of business building block model (hereafter BM) [12]. The various strategic approaches to SMEs innovation from many related organizations would be improved by the analytical manner of the BM. And this strategic research results in a HPC service model that organizations related to HPC R&D and service providers would adopt as a strategic plan for providing their services to innovative SMEs.

The BM, so called ‘business model canvas’ was contrived to establish a strategic management and be used as a template for developing new or documenting existing business models [13]. It is a visual chart with elements describing a value proposition, infrastructure, customers, and finances, and assists stakeholders in aligning their activities by illustrating potential trade-offs. In setting up the strategy and HPC service model for invigorating HPC technology of small industries, we have reconstructed the business model in accordance with HPC service perspectives.

In chapter 2, we describe the basic concept of the BM and its availability for planning an innovative strategy. In chapter 3, we present a HPC service model in terms of the BM. Two practical application cases are shown in chapter 4.

2. Building blocks of business model

In order to make a strategic plan for invigorating SMEs to utilize HPC technology and to result in economic breakthrough through HPC innovative advantages, we consider a method for business model planning presented by Osterwalder [12]. It provides prescriptive guidance and architecture about how to build the new business model. This approach has been effectively applied to Nintendo, Amazon.com, Apple, Google and many others. The core artifacts are composed of the nine building blocks that are mapped on business model canvas.

This business model concept provides a coherent framework that takes technological characteristics and possibilities as inputs and transforms them through customers and markets into economic outputs. The business model can be described as an abstract conceptual model that represents the business economic benefits incoming planning of the company [12]. It is a conceptual tool that contains a set of elements and their relationships and allows expressing the business strategy of specific organizations. It is a description of the value a company offers to segments of customers and of the architecture of the organizations and their network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams [15].

The BM is basically composed of nine blocks: product perspective (1. value propositions), customer perspective (2. customer segments, 3. channels, 4. customer relationships), activity perspective (5. key resources, 6. key activities, 7. key partnerships), and financial perspective (8. revenue streams, 9. cost structure). The value proposition seeks to solve customer problems and satisfy customers’ need with value proposition. The customer segment is for customers served by an organization. Value propositions are delivered to customers via communication, distribution, and service delivery channels. The customer relationships are established and maintained with each customer segment.
Fig. 2. An industrial HPC service model. Each segment of business building blocks is denoted in rounded corners and violet-shadowed boxes.

The key resources are the assets required to offer and deliver the previously described elements. The key activities are arranged in a specific way to be needed for the value proposition, and the customer relationships. The key partnerships portray the network of cooperative agreements with other companies necessary to efficiently offer specific services. The revenue streams describe the way a company makes economic benefits through a variety of revenue flows. And the cost structure sums up the financial consequences of the means taken in the business model.

The business model could be rearranged into the business model canvas. Mutual relationships of the nine functions of the business model are delineated in Fig. 1. In this paper, we have adopted the building business model to a strategic planning for the HPC service and have filled contents with regard to attribute of HPC service.

3. A HPC service model on industrial innovation

3.1 Preliminary settlement

Before figuring out a concrete strategic service model, we should set up a vision and final goal of the service model for SMEs as preliminary conditions. The conditions would designate the whole direction of making and performing the service strategy. For example, HPC service providers could establish the vision that they assist SMEs to achieve global competitiveness with manufacturing their world class quality of products. And the goals would be also beforehand set up in a way of separating medium and long terms. Annual goal in the side of industry would be to promote innovative SMEs to “Hidden Champion”. Otherwise, popularization of utilization of HPC in industrial R&D would be a goal of HPC service providers.

3.2 An HPC service model

In order to establish and restructure the nine building blocks model in a point view of HPC service, we conform with a planning frame that each strategy for the segmental elements should give an answer many of the questions in which the segment is concerned, and the answers could give rise to implementation strategies of each segment. We exactly describe the basic concept and meaning of the segment elements and raise questions with respect to HPC service.

3.2.1 Customer segment

The customer segment can be defined as the different groups of people or organizations. This segment is the heart of any business model. Without customers, no service provider can survive for long. In order to better satisfy customers, a service provider may group them into distinct segments with common needs, common behaviors or other attributes. A business model may define one or several
large or small customer segments. A service provider should make a conscious decision about which segments to target and which segments to ignore so that a business model can be carefully designed around a strong understanding of specific customer needs.

The customer segment should be designed with the questions about for whom should create values and who is the most important customers. As a matter of course, an HPC service provider may define SMEs, ventures and mid-sized enterprises as customers. And these customers may be classified according to necessity of Modeling, Simulation and Analysis (MS&A), capacity of MS&A through utilizing HPC, and possibility of achievement of outcomes.

3.2.2 Value proposition
The value proposition defines how items of value are packaged and offered to fulfill customer needs [4]. It gives an overall view of the services and products that represent value for a specific customer segment. And it describes the way a service provider differentiates itself from its competitors and is the reason why customers are provided with the services from a certain organization and not from another. A value proposition creates values for a customer segment through a distinct mix of elements catering to the customer’s needs.

The value proposition must be defined with the basic question about what values the HPC service providers offer their customers. In general, the value proposition that HPC service providers may mainly compose immaterial values: reduction of development cost and time through using HPC, improvement of performance and quality, enabling very difficult or important R&D’s, raising awareness of importance about HPC technology, increasing revenue growth, producing excellent product design, and improving of safety and risk reduction.

3.2.3 Channels
The channels can describe how a service provider communicates with its customer segments to deliver a value proposition [14]. Channels are connection point with customers. The primary purpose of the channels is to make the right quantities of the products or services available at the right place, at the right time to the right people [16].

The channels may be defined with the questions about what channels are to deliver values to the customer group, how is the values delivered to the customer group, which channels are the most effective in terms of cost and productivity, and how proper the works for the customers group and the channels are integrated. With the perspective of HPC service provider, the channels may be described with dispatching R&D researchers to the customers, providing HPC MS&A techniques through co-works and education, holding conferences, workshops, and societies, and doing press releases.

3.2.4 Customer relationships
The customer relationships can be defined as the types of relationships that an organization establishes with specific customer segments. The organization should clarify the type of relationship it wants to establish with each customer segment. It deeply influences the overall customer experience, and may be classified into several categories in manner of relationship between service provider and customer.

The customer relationships can be described with the question about which relationship is established, and how the relationship between service provider and customer is constructed and maintained. HPC service providers may establish the customer relationships in three relationships. The HPC organizations could shore up the R&D of their customers with direct technical supports, such as dispatching researchers to companies of the customers and doing research with using HPC infrastructure including CAE software on behalf of the customers. HPC service providers usually have HPC facilities to be provided to public side as well as industries. When the customers want to use them, they could utilize HPC to achieve their aims by themselves. In this case, HPC organizations only provide HPC infrastructure without any direct supports. And as a final customer relationship, HPC organizations could make a relationship that the customers are available to use customized HPC environments established by the HPC service providers. The HPC environments are usually designed to effectively and efficiently perform various activities related to industrial product design.
3.2.5 Key resources
Almost business model requires assets (key resources) to allow the business model to fulfill functions. The resources enable an organization to make and offer a value proposition, maintain relationships with customer segments.

HPC service providers must give answers to the question about what are key resources to be needed for the value proposition, the channels, and the customer relationships. Key resources at the side of HPC organizations may be HPC hardware (including dedicated HPC system for their customers), high-speed networking, visualization systems, MS&A software (including in-house and open source software), data set of various types and human resources.

3.2.6 Key activities
Each organization should and needs to perform a number of activities to successful fulfill the customers’ needs. The key activities are representatives that are of the most importance to the organizations and provide the most differentiated service different from other organizations.

The key activities of the HPC service providers could be made by giving answers to the question about what are key resources to be needed for the value proposition, the channels, and the customer relations. So, the key activities may be technical supports for product development from the customers, and analyzing data set with using AI, securing a budget for the customer supports, establishing and compensating policies related to promotion of innovative SME through HPC, establishing dedicated HPC environment for SMEs, and performing public relations.

3.2.7 Key partnerships
The key partnerships are built with the network of assistants that enable the business model to function. Every organization persistently expands the key partnerships for various reasons, and the partnerships become a basement for successfully performing the business model. Thus, they usually create alliances to maximize their business models, reduce risks, resolve their own limitations and acquire resources.

The key partnerships could be generated by giving answers to the questions about who are key partners, who are key providers, and what the key partners carry out. Key partners at the HPC service providers may be government offices, HPC hardware providers, HPC MS&A software vendors, universities, and other HPC service providers (domestic centers as well as international ones).

3.2.8 Revenue streams
The revenue streams mean the incomes which organizations including profit and non-profit ones generate from their customer segments. Generally, the revenue streams are obtained due to delivering value propositions to customers. There are several ways to generate revenue streams such as asset sale, usage fee, subscription fee, lending/renting/leasing, licensing, brokerage fees and advertising [14].

The structure of the revenue streams of HPC service providers is quite different from that of profit organizations. Most of HPC service providers have been non-profit organizations, and their revenue streams come from mostly national or regional government and partly their customer segments (industry sectors). In order to get a fund from the government, HPC service providers are used to propose a concrete planning for their services toward their customers. When a HPC service provider takes technical supports to customers (small or large companies), the customers may pay for the service from the HPC provider. HPC service providers have to keep in mind that they have performed a more valuable service supply and satisfy customers’ needs.

3.2.9 Cost structure
The cost structure is defined as all costs incurred to operate the business model. Every segments of the business model as well as developing and delivering values, maintaining customer relationships and generating revenue all incur costs. Such costs can be calculated relatively easily after defining key resources, activities, and partnerships.

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The cost structure may be constructed with answering the questions about which cost is the most important, which key resources are the most expensive to be secured, and which key activities are the most expensive to be secured. With successful answering above questions, the cost structure is composed of several items: budgets for maintaining and operating HPC HW and MS&A soft wares, personal expenses of organizing members, R&D cost for establishing the dedicated HPC infrastructure for the customer segments, and cost for education/training.

3.3 An industrial HPC service model
We have considered the BM in a point view of HPC service. The HPC service model canvas described above is summarized at Table I. On the basis of the service planning strategy of the business building blocks model canvas, we have made an industrial HPC service model (Fig. 2). Actually, the HPC service model has been applied to the SME supercomputing program from KISTI, S. Korea.

4. Practical application cases
In the previous chapter, the basic elements for establishing a strategy of business model has been described based on business building blocks canvas and adapted for setting up an HPC service model. In general, an organization has been used to complete a strategic business model with analyzing and synthesizing the whole business segments. Thus, the business building blocks canvas strategy surely plays a significant role in designing a holistic business model. As the integrated HPC service models that have been performed, two practical application cases are presented in this chapter.

4.1 An HPC service framework for innovation of SMEs
HPC or supercomputing is not only about technology but also about the people and organizations who are key to the further progress of these technologies and about the complex web that connects people, organizations, products, and technologies (c.f., Fig. 3). So, a veritable supercomputing can be realized only when all parties which enable users to achieve values from HPC are fully satisfied to an optimum level. Unfortunately, this is not the case in all of industries, especially small ones, SMEs today.

Basically, an HPC service model for SMEs (Key customers) should be designed with basic concept of supercomputing elements enabling the SMEs to come true their objectives. A HPC service framework is composed of 4 components: 1) HPC R&D environment for SMEs, 2) joint research and consulting, 3) engineering education and training, and 4) operation by a coordinative committee formed from SMEs, academia, and institutions.

It is very difficult for SMEs to use HPC infrastructure by themselves. Actually, they have to obtain
### Table I. An HPC service model canvas.

| Perspective/Building block          | Description                                                                 |
|------------------------------------|-----------------------------------------------------------------------------|
| **Product/Value proposition**      | Reduction of product development cost and time  |
|                                    | Improvement of performance and quality                                      |
|                                    | Enabling very difficult or impossible R&D                                    |
|                                    | Raising awareness for companies and products                                |
|                                    | Increasing revenue growth                                                   |
|                                    | Excellent product design                                                    |
|                                    | Improvement of safety and risk reduction                                    |
| **Customer/Customer segments**     | Industry sector: SMEs, ventures, and mid-sized enterprises                  |
|                                    | Classification of the target industries according to the necessity of MS&A,  |
|                                    | the capacity of MS&A through HPC, and possibility of achievement of outcomes |
| **Customer/Channels**              | Dispatching R&D researchers to the customers                                |
|                                    | Providing HPC MS&A skills through co-works and education                    |
|                                    | Holding conferences, workshops, and societies                               |
|                                    | Doing press release                                                         |
| **Customer/Customer relationship** | Direct relationship: technically supporting the customers with the man-to-   |
|                                    | man manner                                                                  |
|                                    | Indirect relationship: providing only HPC resources                         |
|                                    | Customized relationship: porting PC-based code into HPC, product design      |
|                                    | through visualization tools                                                 |
| **Activity/Key resources**         | HW: HPC itself, high-speed networks, Visualization infrastructure           |
|                                    | SW: MS&A SW, in-house SW, open source SW                                    |
|                                    | Data resources: data set of various types                                   |
|                                    | Human resources: domain specialists                                         |
|                                    | Dedicated HPC infrastructure for the customers                              |
| **Activity/Key activities**        | Technical support for product development of SMEs                          |
|                                    | Technical support for analyze data set with AI                             |
|                                    | Security of budget for the support for SMEs                                |
|                                    | Establishing and compensating HPC policies                                  |
|                                    | Establishing a dedicated HPC environment for SMEs                          |
|                                    | Providing data set of various types                                         |
|                                    | Outreach                                                                    |
| **Activity/Key partnerships**      | Government offices                                                         |
|                                    | HPC HW providers, HPC MS&A SW vendors                                      |
|                                    | Universities and institutes                                                 |
|                                    | HPC centers (domestic and international)                                    |
| **Financial/Revenue streams**      | Government R&D fund                                                         |
|                                    | Matching fund from the customers                                            |
|                                    | Investment of large companies                                               |
| **Financial/Cost structure**       | Maintain and operation of HPC HW and MS&A SW                               |
|                                    | Personal expenses                                                           |
|                                    | R&D cost for establishing the dedicated HPC infrastructure for SMEs         |
|                                    | Education and training cost                                                 |

the optimized product design from supercomputer and engineering software. Thus, the supercomputing R&D environment appropriate for SMEs should be set up keeping in mind the actualities of SMEs. HPC service organizations would gather the actual demands and current innumerable problems, and establish a CAE platform for product design, validation, and optimization based on HPC technology to be easily and conveniently used.

In the product design processes, SMEs are very interested to know how the product design could reflect their customers’ demands, and to effectively perform the process in a short amount of time. To enhance the SMEs' design and validation process, an HPC service organization, KISTI has combined product design and validation processes with CAE software under HPC environment to build an automatic product design system (e.g., “FAN Simulator”, c.f., Fig. 4) that is operated on a web portal.
The product design and validation system makes SMEs enable to readily achieve their objective. As another HPC product design environment, KISTI have made a suitable and optimized product design platform (e.g., “Large-Scale Realistic Design Platform”, so called LARD, c.f., Fig. 5) covering geometric design, product CAE simulation, and optimization processes through CAE technology based on HPC environment.

SMEs are often under pressure to meet the deadline of a new product launch. Small companies are usually required to make good designs of products from large companies or government. In their R&D processes, the specialists from HPC organizations would provide engineering and HPC techniques to the SME engineers and support them for product design, CAE simulation, and reviews with the SME developer’s demands. In this joint research process, the specialists frequently give valuable advice to SMEs with regard to obtaining an engineering CAE model and choosing CAE software.

KISTI have performed a joint research program, so-called “SME Supercomputing” from 2004 to
Fig. 6. Annual change of SME supercomputing program. Red bars delineate the number of SME supported by the Korean government and blue bars KISTI itself. The upward sloping line reflects the cumulative annual number of SME supercomputing subjects.

present. Through the program, KISTI has supported about 422 numbers of Korean SMEs (c.f., Fig. 6), thereby they have achieved the economic benefits for product design cost and time reduction of over 50%, respectively [8]. Furthermore, some SMEs have become the Hidden Champion industries through the SME supporting program from KISTI. This program has been financially supported by a Korea governmental agency, SMBA (Small and Medium-sized Business Administration).

Education and training for the engineering skill is required for SME developers to maintain their R&D without any assistance from HPC specialists or others. In the education and training course, CAE specialists would teach the usage methods of various engineering commercial software (e.g., CFX, ANSYS, FLUENT, ABAQUS, and LS-DYNA etc.) and open source ones (e.g., OPEN FOAM, Code-Aster, SALOME, Impact, Elmer, Gmsh, etc.). The CAE education could typically include training course with realistic industrial problems.

Generally, whenever companies have a plan to release their new products, they are used to take the strategic approach for dominating the market in advance. However, SMEs do not have sufficient means for laying out a complete plan for the new business. To assist the SMEs when launching a plan for the products, coordinative committee would be needed. Usually, the committee would better be composed of specialists who are good at various domain, CAE engineering, analysis of market response, and HPC. SMEs could consult for the market prospects of the new product, master-plan of CAE simulation, and evaluation of products with domain specialists of the committee.

4.2 A public-private partnership for US SMEs’ innovation

NDEMC, a public-private partnership, was founded in 2010 by three university supercomputer centers, four FORTUNE100 manufacturers, the National Center for Manufacturing Sciences, and the U.S. Council on Competitiveness. John Deere, GE, Lockheed Martin, and P&G each invested $500,000 of cash and in-kind services, matched equally by the U.S. Economic Development Administration (EDA). Small and medium manufacturers (SMMs) were chosen by each Original Equipment Manufacturer (OEM) to participate in advanced digital modeling and simulation at no cost. The pilot lasted approximately thirty months.

Initially, two suppliers per OEM were chosen, with advanced modeling and simulation capabilities ranging from none to modest. In each case, these companies were utilizing 2D geometry CAD (Computer-Aided Design) packages while some companies were using 3D modeling applications on desktop computers. None were using high-performance computing.

The initial scope for NDEMC was to concentrate on 3D simulation training that used well-known commercial off-the-shelf (COTS) codes. Structures and fluids are two fundamental engineering do-
mains with a handful of commercial codes that HPC centers, as well as small manufacturers, would be familiar with.

One of John Deere’s suppliers is Adams Thermal Systems, a charge air cooler (CAC, or radiator) manufacturer in South Dakota. John Deere’s desire to engage Adams Thermal was due in large part to the impact the radiator has on the efficiency of (and emissions from) an internal combustion engine. As one can imagine, the radiator on a tractor is large, and design decisions impact the placement of hoses for fluid inputs and outputs, the speed of fluid transport, the angles of turns, widths of openings, density of cooling fins, placement of welds, and more. Better-informed initial design choices produce longer lasting parts and assemblies and more efficient fuel consumption.

Digital design of experiments, or experimental design, is the design of any information-gathering exercise where variation is present. Iterative designs will help an engineer optimize a design, and running multiples of these designs are aided significantly by HPC in two ways: 1) running on a larger number of processors and 2) running multiple simulations at the same time. The typical platform for digital design is a computer workstation.

Adams Thermal would run a single CFD simulation on a workstation for three days. NCSA’s first task was to take the same input file used on the workstation and run it on as much of a supercomputer as possible, using the identical CFD application. Immediate improvements were achieved with this effort, running efficiently up to 192 cores from 8 on a workstation, reducing runtime from three days to three hours. In essence, the simulation easily ran on 24 computers instead of one. Success!

A family-owned John Deere supplier in Iowa designs and produces hydraulic cylinders and machine parts for a variety of markets. Rosenboom engineers had no experience with 3D digital design simulation software, yet wanted to make more informed decisions about multiple design options within the typical single week allowed to bid for customer business. The initial strategy was to train the company engineers on CFD tools so they could more quickly and accurately analyze the behavior of hydraulic fluid in a cylinder.

Rosenboom engineers were thrilled with what CFD tools could do for them, quickly proving their return on investment (ROI) of time by using CFD to reduce six to ten potential cylinder designs to a single optimal design with a measurable reduction in uncertainty. Rosenboom increased export sales by $7 million and hired 150 new workers during the project.

5. Conclusion
Considering changes in social technological circumstances such as the Fourth industrial revolution, we have described the business building block canvas that has used to be adapted in general business sectors, and reconsidered on HPC service model that HPC service organizations would take a strategic planning to provide their own abilities to small industries (SMEs). The segments of the business building block canvas have been redesigned from the perspective of HPC service with which HPC service providers have properly engaged in their user supports for the technological innovation of SMEs.

We have taken a restructuring process of the business building blocks canvas to make an innovative service strategy that HPC service organizations would adopt as their own user service model. Actually, the economic benefits of SMEs through adopting HPC services provided from the HPC service organizations effectively and efficiently increase when the HPC service model is proportionate, targeted to the industrial present problems and introduced only when absolutely necessary. Many HPC service organizations in the world have engaged in HPC user support programs for the industries [10, 11]. They also have established the HPC service strategy for the industries. The approach of the business building blocks canvas would help the HPC organizations to analyze and restructure the strategy.

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