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How to Implement Innovation and R&D in SMEs

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Abstract: This paper considers innovation and R&D in SMEs. Even those with understanding of the important role innovation plays in sustainable development are hampered by scarce financial resources and the uncertainty of immediate returns especially in case of SMEs. To solve this dilemma, we focus on two approaches by SMEs. There are the pursuit of competitive funds for promoting innovation, and Collaboration and complementarity among SMEs in case of Kyoto Shisaku Net which is joint-order system in Kyoto Japan. From the former survey, we found that problems of the shortage of financial resources and maintaining sufficient resource mobilization for innovation cannot be fully accomplished with government aid. The latter survey, we found that the key functional areas of the joint-order system of Kyoto Shisaku Net.

Key words: SMEs; innovation; R&D; legitimizing resource mobilization
JEL code: M1

1. Introduction

It is widely accepted that companies must innovate in order to achieve sustainable development and company growth. Many studies have established the relationship between a company's success and innovation. For example, Teece (1986) understood that innovating firms often fail to obtain significant economic returns from an innovation early on; however, he insisted that innovating firms must establish a prior position in these complementary assets. Nonaka and Takeuchi (1995) insist that the secret of success for many Japanese companies lies in creating the dynamics of innovation. Chesbrough (2003) points out the value of open innovation for companies. The open innovation model describes a process in which R&D projects are launched based on either internal or external knowledge and technologies, allowing new knowledge and technologies to enter into the R&D process. Not only are there many ways for new knowledge and technologies to flow into this type of R&D process, but open innovation also facilitates the outflow of knowledge into the competitive market.

However, it is difficult for SMEs (small- and medium-size enterprises) to continue implementing innovation and R&D. Even those with a clear understanding of the important role innovation plays in sustainable development are hampered by scarce financial resources and the uncertainty of immediate returns. How SMEs can solve this dilemma is the theme of this study.

This topic is of vital importance to Japanese SMEs, including many that are members of supply chains and KEIRETSUs of large electronics companies and carmakers. These have struggled to expand in the face of increasing requirements. This underscores the need for Japanese SMEs that are members of supplier networks and

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KEIRETSUs to aggressively pursue innovation.

2. Review

There are three important studies that inform our thinking about innovation among SMEs.

2.1 The Uncertainty of Implementing Innovation

Innovation always entails uncertainty (Teece, 1986; Takeishi, Aoshima, & Karube, 2007). We do not know in advance whether innovation is going to succeed or fail. We can only understand the outcomes afterward. Nobeoka (2006) analyzed uncertainty by separating it into three constituent factors in the context of management of technology. These factors, namely, uncertainty of technology, uncertainty of customer needs, and uncertainty of competitive environment, are very complex in terms of explaining the causes of innovation and its results.

It is true that some companies experience unexpected and extreme successes from innovations, results that were unforeseen and impossible to estimate in advance (Takeishi et al., 2012). On the other hand, Gerstenfield (1970) investigated 91 governmental projects in the United States and found a success rate of only 32%. This was cited in public remarks by Robert C. Cresanti, Under Secretary for Technology in the U.S. Department of Commerce's Technology Administration, referencing the National Institute of Standards and Technology (NIST)[1]. Much research and many wonderful ideas might fail repeatedly before producing a successful business model. This period of failure is commonly known as the "valley of death" and shows that innovation's path to success is not an easy one. SMEs' financial and management resources are typically limited, meaning they cannot afford to risk the resources necessary to pursue innovation because of the uncertainty regarding success. This fact has reduced the incentive to innovate, especially among SMEs.

2.2 Legitimizing Resource Mobilization for Innovation

Takeishi et al. (2012) analyzed 25 cases of project winners of the Okochi Memorial Prize[2], to explain the mechanism of legitimizing resource mobilization for innovation and to offer guidance on how to mobilize resources for innovation processes in companies which did not foresee and legitimize such resource mobilization in advance. In the framework of innovation processes in a company, an innovative project with a specific purpose (i.e., one which is not general purpose) can often face difficulties in receiving support. This leaves the members of the innovation project team to address doubts, try hard to legitimize the project, and attract company resources. The mechanism by which resource mobilization is legitimized for innovation is shown in Figure 1. The steps in legitimizing resource mobilization for innovation are as follows: (1) win over potential supporters and increase emerging supporters for a specific purpose for the innovation; (2) increase emerging supporters by expanding the general purpose of the innovation; (3) persuade those who have decision-making power to legitimize the mobilization of resources for innovation. Even if the needs for legitimizing resource mobilization for innovation are high in a company, there are often few resources legitimized because an innovation is too specialized, failing to gain enough supporters. This is known as the "wall of resource mobilization".

From the SMEs point of view, resource mobilization for innovation is not so difficult to legitimize if it is based on the decisions of top management. There are fewer procedural hurdles in SMEs than in large companies when it comes to legitimizing resource mobilization via top-down decision making. Further, top managers of

1 See details from the speech here: http://www.nist.gov/tpo/publications/speechtranspanelculturalinnov.cfm.

2 The prize was founded in 1954 to commemorate the academic and industrial achievements of Dr. Masatoshi Okochi. Since its founding, the Okochi Memorial Foundation has awarded prizes to people and firms achieving outstanding technological innovation every year (Takeishi et al., 2012).

SMEs have longer tenures than those of big companies. Once a decision is made, it is not difficult to implement. However, the most important problem regarding legitimizing resource mobilization for SMEs is a shortage of resources. Even if a company has legitimized resource mobilization for the innovation in question, the amount of legitimizing resources is often insufficient. This is an inevitable problem facing SMEs that want to innovate. The mechanism described above does not solve this problem.

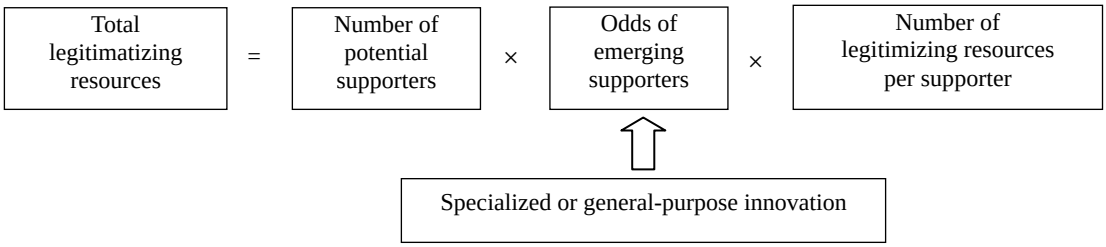

Figure 1 The Mechanism of Legitimizing Resource Mobilization for Innovation

Source: Takeishi, Aoshima, and Karube (2012)

2.3 Exploration and Exploitation

March (1991) considered the relationship between the exploration of new possibilities which could lead to discoveries and the exploitation of old certainties or things already known in organizational learning. March insists that there are challenges in allocating resources between the two. Exploration is necessary in the long-term for companies, but it is costly and uncertain. On the other hand, exploitation without exploration leads to stagnation and failure when it comes to discovering new, useful directions (March, 2008). Exploration and exploitation are both necessary for sustainable company development. Even if SMEs commit resources toward legitimatizing resource mobilization for innovation, they still face the problem of how to balance exploration and exploitation during implementation. Sawada, Nakamura, & Asakawa (2010) investigated how the policies of listed companies' head offices affected R&D performance. This study found that exploration is most important in the first stages of R&D, and exploitation becomes vital in the later stages of R&D. This makes it necessary for management of companies large and small to balance exploration and exploitation for sustainable development.

3. Analyzing the Situation of R&D in SMEs

"It is not easy for SMEs to keep implementing innovation and R&D." Is this statement true? What is the situation? We begin by reviewing data regarding innovation among SMEs.

An annual survey of small and medium enterprises in Japan in 2009 posed the very interesting question of what kinds of challenges SMEs were facing when engaging in research and development (see Figure 2).

Twenty-four percent of SMEs considered one major challenge in research and development to be "inefficient funding for R&D activities". Twenty-one percent of SMEs considered "inefficient worker numbers in the R&D division" as a challenge, and 16% cited "inefficient worker quality in the R&D division". When comparing this with the percentage of similar challenges cited by large companies when engaging in research and development, inefficient funding and inefficient worker numbers for R&D activities were far more common among SMEs.

The percentage of SMEs implementing research and development is much lower than that of large companies, for both manufacturing and non-manufacturing sectors (see Figure 3).

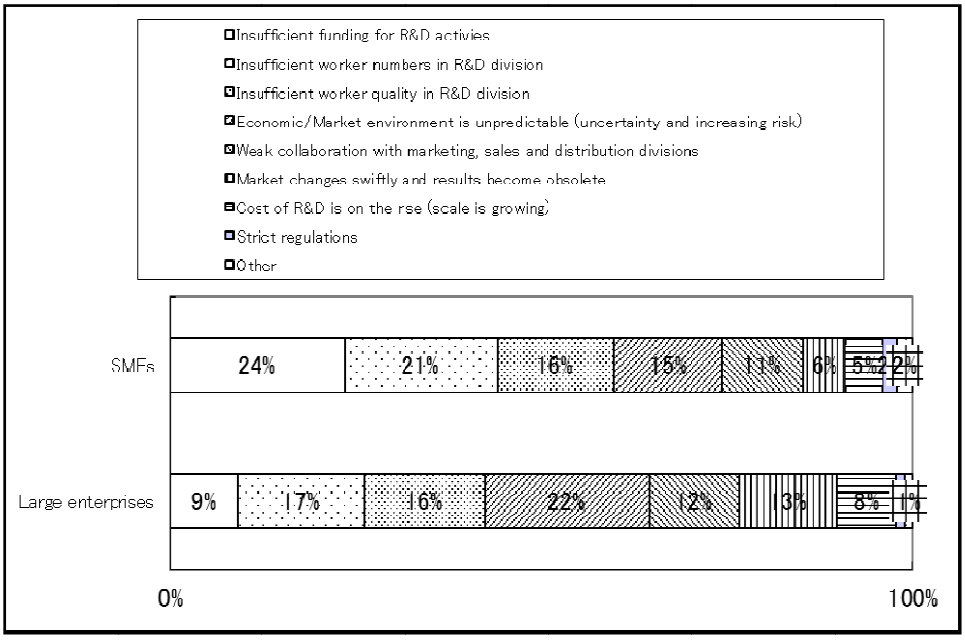

Figure 2 Challenges in Engaging in R&D

Source: Mitsubishi UFJ Research and Consulting Co., Ltd., *Survey on the Innovation Situation through the Creativity and Research and Development of Companies* (December 2008).

Notes: 1. Date for enterprises engaging in R&D; 2. In order to compare large enterprises and SMEs, the number of responses for each item (multiple responses allowed) were summed up and proportionally distributed among each item so that the total of the items made up 100%.

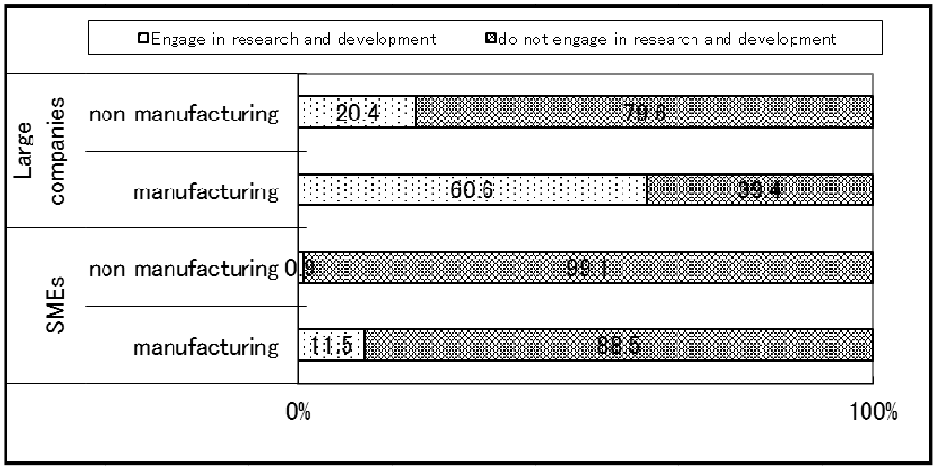

Figure 3 Ratio of Implementation of Research and Development by Company Scale

Source: Ministry of Internal Affairs and Communication, *Survey of Research and Development* (2008)

Notes: 1. Survey targeting about 13,800 enterprises selected from enterprises that have capital of ¥10 million or more. Response rate was about 76%. The date of survey was March 31, 2008; 2. “Engage in research and development” refers to companies that responded that they use R&D spending in-house (internally) or spent R&D funds externally; 3. Enterprises with a workforce of 1-299 are considered SMEs and those with a workforce of 300 or more are considered large enterprises. In this survey, non-manufacturing refers to all industries excluding the manufacturing industry.

In addition, we reference more detailed R&D implementation data for SMEs (see Table 1) that show that the smaller the company, the more likely it is that it is not implementing R&D. Figure 4 shows that companies with between 51 and 300 employees represent about 74% of all SME R&D implementations.

Table 1 Numbers of SMEs Engaged or not Engaged in Research and Development, and the Total Amount of the Expense for R&D.

	Total	Business corporations					Individual proprietorship
		Total	5persons or fewer	6-20 persons	21-50 persons	51 persons or more	
Amount of enterprise	3,654,465	1,668,082	1,088,770	383,955	117,907	77,450	1,986,383
Engaged in R&D	52,025	38,796	12,882	10,230	6,690	8,994	13,230
Not engaged in R&D	3,602,440	1,629,287	1,075,888	373,725	111,217	68,457	1,973,153
Expenditure of R&D (million yen)	542,370	538,622	18,776	42,957	74,088	402,802	3,748

Source: SME Agency, *Basic Survey of Small and Medium Enterprises* (2010).

Notes: 1. “Corporations” refer to incorporated enterprises and “unincorporated” refer to unincorporated enterprises; 2. “51 persons or more” means that the company hired from 51 to 300 persons.

The data show that it is often not an easy task for small SMEs to expend time and money implementing R&D. However, some SMEs find ways to expend time and money for R&D projects.

We identify three major issues facing SMEs with regard to R&D and innovation. These are: a shortage of financial resources, and human capital, uncertainty of results. And the smaller the company, the lower the amount of investment in R&D and innovation.

4. Research Topics and the Method of Research

Given the difficulty of implementing innovation for SMEs highlighted above, we focus on two approaches by SMEs:

(1) The pursuit of competitive funds for promoting innovation, such as those supported by the Ministry of Economy, Trade, and Industry (METI); the New Energy and Industrial Technology Development Organization (NEDO); and the Japan Science and Technology Agency (JST), to solve the shortage of financial resources and reduce the uncertainty of innovation.

(2) Collaboration and complementarity among SMEs, and the practice of SMEs assigning each other when implementing innovation and, thereby, solving the shortage of human resources.

In researching the first topic, we conducted a follow-up survey of companies and research centers, which had been selected to receive government funds between March 2006 and March 2007. These surveys took the form of semi-structured interviews. Even though the data from this survey are limited, due to this being a pilot survey, it may still furnish us with useful information[3]. If the problems related to a shortage of financial resources for innovation were to be solved, would SMEs then become willing to invest resources in innovation? We attempted to answer this question through interviews. Our research includes 30 projects from 25 companies and research centers (Some companies were selected twice). Eleven projects were implemented by the SMEs. One project was implemented by a research center. The other 18 projects were implemented by large companies. The total interview time for our study was 41 hours and 45 minutes.

For the second topic, we study Kyoto Shisaku Net, a network of 18 processing companies in the Kyoto area. Members collaborate and receive trial and prototype product orders through their websites and participate in trade

3 This survey is sufficient in size to verify that SME innovation is supported by government aid, but we intend to investigate further.

fairs geared toward implementing their innovations. Each member plays a different role and takes responsibility within the framework of Kyoto Shisaku Net to overcome problems related to a shortage of human resources. We conducted 39 semi-structured group interviews between 1998 and 2010. The total interview time for this study is 63 hours and 25 minutes.

5. Dealing with the Problems Associated with a Shortage of Financial Resources and the Uncertainty of Successful Innovation

Our survey covered 30 projects from 25 companies and research centers that were selected by government entities based on proposals to develop new technologies, goods, and services. These projects were supported by government funds from NEDO and JST. Government subsidies for the survey group typically paid for up to two-thirds of the total cost of the selected projects. The project list and outline of the surveys are shown in Table 2.

Table 2 List of Participants in the Follow-up Survey

Company	Reason for applying		Effect of being selected		Did your company pay for project cost overruns			Profit
	Shortage of financial resources	Because of high risk	Received attention outside the company	Received attention from inside the company	Paid in advance	Paid during the project	Paid after the project was finished	Not made a profit from the project
Large (18)	10	10	13	6	10	16	8	13
SMEs (11)	6	3	10	1	8	8	10	8
Others (1)			1		1	1	1	
Total (30)	16	13	24	7	19	25	19	21

First, the reasons cited by the selected companies for their aid applications included a “shortage of financial resources”, which was cited by 16 applicants, and “high risk and lack of buy-in from top managers”, which was cited by 13 projects. Half of the SME projects cited a shortage of financial resources. Overall, the SMEs indicated that they could not afford enough to mobilize resources to implement innovations on their own, but would find ways to augment the government funding.

We found that selected SMEs subsequently received a high level of regard from outside company circles. Ten of the 11 SME projects, i.e., 90%, acknowledged this effect. Being selected for the government funding seemed to build trust and confidence, especially among SMEs. One SME won a venture capital investment after its project was selected.

Even with government funding in place, selected companies ran into unexpected implementation costs, forcing them to make unplanned expenditures. This is an indication that companies that pursue government subsidies for innovative projects must still prepare for budget overruns. The reasons for this are: (1) limitations due to complicated bureaucratic procedure of the payment process, (2) unanticipated project costs, and (3) the costs of marketing and monetizing the project after completion.

Twenty-five out of the 30 projects reviewed were compelled to commercialize, the remaining five were considered pure research[4]. Twenty-one of the commercial projects failed to turn a profit by the project end date[5].

4 Fundamental research and development projects are usually not planned to be commercialized.
5 Some projects did not make a profit from the projects even five years after the projects had ended.

Commercializing the projects was a separate problem from completing them. Even if a company commits to a project and implements innovations (that is, solves the financial resources problem of legitimizing resource mobilization for innovation), it is still not easy to profit financially. One of the reasons for this is that in many cases, companies, especially SMEs, fail to find outlets for their new technologies and products, even if the new product is a technical success. Another reason is that many companies submit plans based on their current technology. Because the applicants who are selected face severe deadlines and are required to demonstrate the results of using the government aid in the short-term, this type of innovation tends to seek a "technology-push". Technology-push innovations are often not concerned with users' response or users' needs (Tidd, Bessant, & Pavitt, 2002). In March's (1981) context, this type of innovation is applicable to "exploitation" because knowledge and technologies that are already possessed are diverted to new products and technologies. Even "exploitation" is not easily made profitable. Some interviewees said, "We did meet our product deadline; however, the final product's price was so high that consumers could not afford it." Other interviewees said, "Everyone loved the new product we developed using government aid; however, its initial cost to consumers is too high."

Considering the survey mentioned above, solving the SME problems of the shortage of financial resources and maintaining sufficient resource mobilization for innovation cannot be fully accomplished with government aid. Even if SMEs solve the problem of allocating sufficient financial resources, other problems remain. In the next section, we analyze the case study of Kyoto Shisaku Net which addresses these problems.

6. Addressing the Problems of a Shortage of Human Resources and Reducing the Uncertainty Surrounding Innovation: A Case Study of Kyoto Shisaku Net

6.1 About Kyoto Shisaku Net[6]

Kyoto Shisaku Net consists of 18 companies. Each member has a unique technology and technology differentiation has been achieved. The network's chief activities are the development of prototypes and trial products, and participation in tradeshows that showcase innovation. One of the aims of the network is to meke a joint-order system. The founding members of Kyoto Shisaku Net shared the experience of being members and leaders of Kyoto's Kiseiren, which was a group of SMEs mainly in the machinery and metal processing industries, formed for the purpose of improving and encouraging each other's economic survival and sustainable development. For example, the Kiseiren's activities were guided by the writings of Peter Drucker (Drucker, 1954), which encouraged the exchange of knowledge regarding how to survive severe business situations. This guidance proved very useful to young Kiseiren company leaders and their successors. However, to qualify as a member of Kiseiren, managers had to be younger than 45 years old to keep the organization fresh. When a member reached 45, he or she graduated from Kiseiren. Kiseiren graduates lost the chance to learn from each other and, therefore, decided to meet and create new businesses and find new customers. This became Kyoto Shisaku Net.

The aim of Kyoto Shisaku Net is to test, achieve, and create new innovations, businesses, or customers based on the idea that what a single member cannot implement on their own, the group can accomplish. All members agree to: (1) share and assign costs and burdens, (2) actively suggest ideas and plans, (3) be united with each other, (4) be a cluster of trial and prototype businesses in the Kyoto area, and (5) develop a system of quick response and rapid solutions to customer needs.

Kyoto Shisaku Net participates in trade shows in various areas to promote orders of trial and prototype

6 Details of Kyoto Shisaku Net can be found here: http://www.kyoto-shisaku.com/en/about.

products that exploit innovations in a wide range of industries, from machine technology and micro-processing to aerospace, railroad technology, interior design and living space, and the food service and tourist industries.

The mission of Kyoto Shisaku Net is: (1) to create prototypes that exceed customer expectations, faster than anybody else, (2) to make the process of prototyping as easy as possible. The network has three guiding philosophies: (1) to improve development efficiency by working with customers from the initial stage of product development and providing development proposals from the participating companies; (2) to apply the shared knowledge and solutions, and add value during the creation of prototypes; (3) to provide members with an opportunity to grow and advance in their manufacturing and prototyping capabilities. Kyoto Shisaku Net has a policy of replying to customer inquiries within two hours.

6.2 Characteristics of Kyoto Shisaku Net

We identify five characteristics of Kyoto Shisaku Net. First, representatives of member companies must come from the ranks of top management. One of the strengths (or competitive advantages) of Kyoto Shisaku Net is speed. The network does, in fact, reply to consumer request within two hours. Participants must be mobile and quick to respond. Members finalize decisions during meetings, and not after they return to their own companies (and after internal company meetings).

Second, Kyoto Shisaku Net has a formal and strict organizational structure, even though participants are familiar with each other. The trustees' board meeting is held once a month. A committee responsible for administrative and operational affairs holds weekly meetings. When members register for trade shows and exhibitions, they are held responsible since there are no official or full-time administrative staff members supporting Kyoto Shisaku Net. It is surprising that every member company has to accept the requirement of committing two top salespeople to work as Kyoto Shisaku Net's operational staff. These assignees must attend a meeting of the operational affairs committee once a week and develop a clear understanding of all member companies' technologies, equipment, and competitive advantages in order to promote Kyoto Shisaku Net. Administrative tasks are shared by all members. All members check inquiries that arrive via mail and fax, and take turns estimating the value and cost turnoff, with each member sharing this information with the group.

Third, every member pays an annual fee. Current members pay a fee of 50,000 yen (about 500 US dollars) each month (the annual fee is 600,000 yen[7]). The fees are used for maintaining Internet and security infrastructure and paying registration fees for trade shows.

Fourth, each member's technologies and specific business field are different. If members' technology and business fields overlap, this poses a high potential risk for cannibalization among members. Even if members have the same machinery and processing equipment, it is important that they remain differentiated from each other and divide their business areas, processing capacities, and methods.

Fifth, Kyoto Shisaku Net has established a new member system in order to expand the scope of its specific technologies and capabilities for joint development. Existing members do not expand their scope of specific technologies and business fields; instead, they decide to invite new members. However, members are careful in their selection of new members for two reasons: (1) to ensure that the principles and philosophy of Kyoto Shisaku Net do not collapse, and (2) to avoid overlap and cannibalization. In general, the joint order system risks collapse because of conflicts of interest and power struggles among members. In such cases, certain members use the

7 First-time members pay 100,000 yen (the annual fee is 120,000 yen) for the first few years, to offset the high costs of Internet service and security infrastructure.

system only to generate profits; thus, the joint order system becomes a zero-sum game. To avoid this situation, all members must accept the principles and philosophy of Kyoto Shisaku Net and understand how to act as members. The new member system involves a study and training period of six months, and a monthly fee of 20,000 yen. During the study and training period, candidates for membership have to study Drucker (1954) under an instructor who helps them understand the fundamentals and history of Kyoto Shisaku Net. Because the founding members all read Drucker (1954) while being part of the Kiseiren. They were deeply impressed by Drucker's message concerning ways to create customers and markets[8]. All members understand and share Drucker's philosophy and the aims of Kyoto Shisaku Net. During the study and training period, candidates for membership are also required to learn the systems, business areas, and technologies of each existing member. Candidates must receive the approval of all existing members in order to become official members of Kyoto Shisaku Net.

6.3 Kyoto Shisaku Net from the Standpoint of Existing Members

There are three main reasons for becoming a member of Kyoto Shisaku Net. First, each member recognizes that Kyoto Shisaku Net gives them the chance to achieve new innovations which no single company could achieve. They recognize that profits have to be earned individually and not by Kyoto Shisaku Net. All members agree to this from the beginning. Therefore, members do not look to make profits in the short-term but consider membership as an investment and an opportunity to try new things and build their company's future prospects. One member said: "As for me, Kyoto Shisaku Net provides the opportunity to implement innovation based on the 5% rule." The 5% rule calls for 5% of profits and time to be put into new technologies and business areas to sustain company development. All members share this concept and practice it. The process of implementing innovation among members in Kyoto Shisaku Net entails the accumulation of experience and know-how through trials and prototyping products jointly. This is the attribute of greatest value to each member, and is the reason why members agree to pay the annual fee and provide two operational staff to Kyoto Shisaku Net, even if the return on investment is not high in the short term.

Members receive a lot of information through the activities of Kyoto Shisaku Net that they cannot get on their own. They get new information by participating in trade shows and developing trial and prototype products. For example, members are exposed to business trends, movement, and latent needs. Requests from customers of trial and prototype products are based on customer needs and contain information regarding future trends. This allows members to implement innovation from the standpoint of customer needs and not technology-push. Members are implementing innovations based on customer visions, needs, and orders. Further, attending trade shows for various industries gives them the chance to learn, break new business ground, and develop new trade relationships.

Third, Kyoto Shisaku Net sends out information on behalf of the group, and not on behalf of single members[9]. This has two merits: (1) When a single member releases information, it is usually dismissed by the business world. However, when all members join their messaging efforts regarding something new, interesting, or innovative, SMEs and the mass media pay attention; and (2) Single companies cannot easily persuade others of the merits of their new technology, as others cannot see the potential of new innovations. However, being differentiated among network members makes it possible to increase visibility and showcase products and technologies[10].

8 Drucker (1954) is considered the bible for all existing members of Kyoto Shisaku Net.

9 To make the most of this, it is necessary for Kyoto Shisaku Net to send out attractive and influential information to others. We will point out and describe this process in the next section.

10 They made original art with eggshells (despite the thinnest part of the eggshell being 0.1 mm thick). Other art projects include an

6.4 Point of the Case Study

We highlight three points from this case study. One is a method for solving the risk and uncertainty of implementing innovation in SMEs. In the case study, network members received joint orders of trial and prototype products based on customer needs, and they understood this to be an opportunity to implementing innovation. This is important for two reasons: (1) implementation of innovation should be based on customer needs so that the activities are not based on a "technology-push"; and (2) customer orders represent a chance to implement innovation jointly, so that an individual member does not have to pay all the expenses associated with the innovation.

The second issue we identify concerns how Kyoto Shisaku Net overcomes the limited technological scope that typically restrains many SMEs. In the case study, by sharing a unified aim and philosophy, members cooperate and create technological differentiation from one another allowing the network access to a wide range of technologies and a broad scope of merits. It is important that members understand the philosophy of Kyoto Shisaku Net that is to implement innovation for the long-term sustainable development of each member.

The third issue of the case study concerns how companies balance exploration and exploitation. In the case study, members do not implement innovation based on their own technology but, instead, based on customer needs. This means that the projects are not "technology-push" innovations. Customer orders give members an opportunity to prototype products, which have never been made before, offering them a chance to try new technologies and explore new business areas.

7. Discussion

In the case study, we have three topics to discuss. The first is the significance of consumer-requested trials and prototype products. This might be the key to innovation for SMEs. The second topic involves how to organize this kind of joint order system. Normally, joint order systems do not work because of profit reciprocity[11]. However, Kyoto Shisaku Net has flourished for 12 years. This makes it imperative to find out the key merits of the system. Third, we will discuss how to sustain and expand this type of joint order system. Members make many sacrifices in order to be a part of Kyoto Shisaku Net. Why do they do it?

7.1 The Significance of the Customer Order in Product Prototyping

All members share the concept of the 5% rule, which calls for setting aside 5% of profits and time, for new technology and business areas, to ensure the company's sustainable development. Kyoto Shisaku Net is a framework for implementing this concept. However, the key to making this logic work is that Kyoto Shisaku Net receives orders that will aid members' sustainable growth in the future. Otherwise, members would take part in the activities of the network, risking the collapse of the system. Kyoto Shisaku Net must receive orders for new products which drive innovation for members.

Trials and product prototyping according to order are not routine activities, but demand trial-and-error in order to create new products. By doing this type of work, members are forced to think creatively and be inspired, regarding how to best exploit their own technologies as well as explore new skills and technologies. In this

exploration of the design possibilities of metal cutting and combining metal with various color properties to create visually appealing designs using 3D computer-aided design technology. See the following: http://www.kyoto-shisaku.com/en/chievement/design.

11 The Japan Information Technology Service Industry Association conducted a study of the joint-order system. According to its results, the chief difficulties facing the system were "trouble alleviating conflicts (79%)" and "difficulty distributing work and profits fairly among all participants (60%)".

process, members come to learn, accumulate, and refine technologies and knowledge. This is their opportunity to strategically manage and balance exploration and exploitation, whether they realize it at first or not. By working on joint orders, members gain information and knowledge that goes beyond the work order.

Trial and prototype product orders are not based on technology-push but customer needs; this is known as demand-pull. It is difficult to develop and profit from technology-push-based innovations because of their inherent disconnect from customers' needs and wants. However, members receive information regarding the real needs and wants of customers through orders to Kyoto Shisaku Net. For members, these orders represent a valuable opportunity to pursue innovation. Members must think of how to best exploit their own technologies based on customer needs and wants, and how to explore new technologies and business fields based on the orders. The significance of this is that members will then seek to explore and exploit at the same time, through the joint activities and experiences of Kyoto Shisaku Net.

Further, a single SME typically cannot afford to commit financial and human resources to innovation; the network's joint orders lead to members implementing innovations individually. The financial problem associated with innovation is ameliorated by the prototype orders since this allows companies to receive payments from the orders, though not enough to profit substantially. The problems related to shortages of human capital and limited technological scope faced by many SMEs is solved in the network by drawing on the unique technologies among members and the creation of a team in which members have competing technologies. This competition keeps members from profiting significantly, and despite significant efforts committed to the network activities of Kyoto Shisaku Net, many SMEs still wish to maintain their memberships because of the benefits cited above.

7.2 Organizational Requirements of the Network

It is exceedingly difficult to create a joint-order system that satisfies every member. However, Kyoto Shisaku Net seems to be functioning effectively despite this challenge. We have identified several functional requirements, based on the case study. The first is a shared aim and philosophy among Kyoto Shisaku Net members. Members understand that the joint-order system gives them a chance to achieve sustainable development and innovation for the long-term, and not short-term profits. To deepen the shared mindset, members read and share Drucker (1954) as common "bible", in addition to developing an understanding of other members' unique technologies and how each is differentiated. As a result of these measures, members avoid opportunism, seeing the potential disadvantages of pursuing short-term profits.

The second requirement is for each member to distinguish their individual role and establish the heterogeneity of their technology. Technological differentiation is based not only on technology itself but also on processing capabilities, real estate assets, and on each member's business field. Preventing an overlap in these areas allows the network to avoid cannibalization among members.

The third requirement is for each member to be technologically competitive. Even if a member's specialty is narrow and would not attract attention by itself, once cutting-edge technologies are combined, it increases the visibility of network products and attracts market attention. Each member must take advantage of the groups' technological competitiveness, in ordering for trials and in the prototyping process, to be successful.

7.3 Requirements for Sustaining and Expanding the System

Being a member of Kyoto Shisaku Net is not easy due to the duties and obligations that membership requires. Members pay an annual fee, attend many meetings, and commit two top sales and operational staff members to Kyoto Shisaku Net, in addition to the time and effort required to coordinate among other members. They invest heavily and legitimize their own resource mobilization for the activities of Kyoto Shisaku Net. This leads us to the

question of why members have agreed to shoulder these burdens for the past 12 years and continue to do so. It must be because the benefits of membership outweigh the costs. In the context of March & Simon's (1993) contribution-inducement model of organizational equilibrium, the decision to participate is based on the balance of inducements and contributions. We have identified several inducements for membership. The first is the opportunity to receive orders for trial and prototype products, which individual members would be unable to support on their own. The group dynamic supports the flow of qualitative information to and from members. Since members think and decide what projects to undertake as a group, they are able to brainstorm and find ways to augment each company's overall strategy based on the shared information.

The second inducement relates to members' opportunity to attract attention to send their company's message to the market in ways that would be impossible individually, without the credibility of the group. Even if a single SME has sophisticated and unique technology, it may not have the wherewithal to get its message out or make an impression on the market. However, members who have useful and competitive technologies collaborate with each other to turn these invisible technologies into visible products, and this process receives much attention, especially at trade shows where they gain exposure to potential customers, evidenced by the high level of comments and inquiries members receive at such events.

Further, the activities of Kyoto Shisaku Net build confidence and trust, and lead to credibility in the market. The network's activities not only include the joint-order system and promotional activities such as trade shows, but also educational programs such as conducting university lectures, and reviews by local governments and supporting organizations. This chance to become well-known and to develop a reputation for excellence is an important member-inducement for Kyoto Shisaku Net. Recognition connected with the network will help increase orders and business prospects for member companies.

8. Conclusion

Our research topics are: "SMEs' pursuit of competitive grants for innovative projects as a way to offset their shortage of financial resources and reduce the uncertainty surrounding the payoffs of innovation", and "collaboration among SMEs in which they work together, bringing complementary capabilities to bear on their shared shortage of human resources".

As for the first topic, the pursuit of external funding somewhat addresses the SMEs' financial shortfall, but it is not a complete answer to their innovation problems. Even companies that receive sufficient funding and have assurances regarding the success of their projects face other problems. The first is that successful innovation does not always lead to commercialization. "Technology-push" innovations often fail to reach commercial success because they are disconnected from end users' needs and wants (see Table 2).

This paper also analyzed a case study on focusing on the implementing of innovation via a joint-order system. The key functional areas of the joint-order system of Kyoto Shisaku Net are: (1) a focus not on routine work but prototyping and product trials, which contain an element of innovation based on customer needs and wants; (2) the solution by the network, of the innovation problems faced by the individual member SMEs such as limitations in the scope and scale of their technologies and finances; (3) affording members a chance to balance exploration and exploitation when implementing innovations; and (4) members sharing a common aim, concept, and philosophy, and being technologically differentiated, to prevent cannibalization. In addition, all members were technologically competitive.

To further our research, we must conduct a follow-up survey and do more case studies, as our current set of data is limited.

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