IoT Service Business Ecosystem Design in a Global, Competitive, and Collaborative Environment

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Abstract--**Internet of Things (IoT) is now making a new industrial revolution, which includes "Industrie4.0" in Germany, "Industrial Internet" in US, "Made in China 2025" in China, and the "Industrial Value Chain Initiative (IVI)" in Japan. In the modern global, competitive, and collaborative business environment, IoT services must be designed as a business ecosystem. Although many business-model design methods, including our own design method presented in PICMET2015, have been proposed, there exist few business-ecosystem design methods that target IoT services especially. Here, a business-ecosystem design method is proposed for IoT services using an "Open & Closed Strategy Canvas," on which designers can recognize both a closed area, where the company keeps and strengthens their core competence, and an open area, where complementary companies provide resources (knowledge resource, manufacturing resource, and deployment resource) to the business ecosystem.**

I. INTRODUCTION

Since the 1990s, the Internet has been playing a leading role in innovative changes in our communication and businesses. As the next stage of the Internet, Internet of Things (IoT) has received much attention from both industry and academia. Since IoT is a broad concept, this paper focuses on the Cyber Physical System (CPS), where information is gathered from various sensors through networks, processed for information analytics and optimization in central servers (cloud computing), and finally, used for decision-making and control of the target things. We call a service created by the CPS an "IoT service" in this paper. These services are expected to find use in a wide range of "smart" applications related to home, factory, energy, healthcare, transportation, logistics, and maintenance, and can revolutionize our society. Especially, there are several initiatives to promote IoT services in an industry sector including"Industrie4.0", "Industrial Internet", "Made in China 2025", and "Industrial Value Chain Initiative (IVI)." According to a recent report of the International Data Corporation [1], the worldwide IoT market is expected to grow from $655.8 billion in 2014 to $1.7 trillion in 2020. However, it is not easy for many companies to make successful businesses of IoT services. For example, even leading IT companies struggle in monetization and scaling of IoT service businesses in Japan. Although R&D of IoT has been actively conducted in recent years, these activities mainly focus on the technology itself, and discussions from service marketing and management viewpoints are not enough to develop IoT service businesses. More concretely, re-search on IoT service-business modeling and design methodology is insufficient.

Recognizing the IoT service business difficulties, we have investigated IoT service-business modeling and proposed a method of service innovation structure analysis in PICMET2014 [2] and a concrete modeling method in PICMET2015 [3]. In these methods, an original value analysis model (SCAI model) of IoT services is proposed and combined with a conventional business modeling method (Business Model Canvas; BMC). The proposed method is designed mainly for a company's IoT service businesses, the same as in the BMC method. However, in the modern global, competitive, and collaborative business environment, IoT services must be designed as a business ecosystem. This paper proposes a business-ecosystem design method for IoT services using an "Open & Closed Strategy Canvas," on which designers can recognize both a closed area, where the company keeps and strengthens their core competence, and an open area, where complementary companies provide resources (knowledge resource, manufacturing resource, and deployment resource) to the business ecosystem. Although many scholars have mentioned the structure of business ecosystem, concrete business-ecosystem design methods are not yet established, especially for IoT services. In this study, we provide a concrete procedure for the proposed method by using examples including a smart house and a smart factory.

The remainder of the paper is organized as follows. Section II briefly reviews the literature on IoT businesses. The IoT service business-ecosystem design method is proposed in section III. We apply the proposed method to a smart home and a smart factory, as examples, in section IV. Section V includes a discussion on related research issues, and Section VI gives our conclusions.

II. LITERATURE REVIEW

IoT is a wide-ranging concept, including Machine-to-Machine (M2M) communication and CPS. Many studies have discussed and surveyed the functional features of IoT, M2M communication, and CPS technologies that show mainly technological possibilities and issues [4–9]. However, technological potential does not always result in suc-cessful businesses. Business model features should be investigated in detail, in order to lead IoT services to success.

Recently, some studies have included IoT/M2M business analysis and proposed IoT/M2M business models. Laya and Markendahl compared typical M2M cases, including smart cities, smart houses, e-home care, and smart energy systems, and analyzed the key factors of success and failure of M2M businesses [10, 11]. Goncalves and Dobbelaere showed 11 roles and the value chain among these roles. They extracted three M2M business scenarios: application stream, mobile stream, and consumer electronics device stream [12]. Leminen et al. proposed a framework for IoT businesses. They analyzed several concrete cases from the automotive industry [13]. Although those analyses revealed some aspects of IoT/M2M businesses, they did not go beyond the analysis of currently implemented businesses. Major gaps remain between analysis of existing IoT/M2M businesses and design and modeling of new IoT/M2M businesses.

The BMC [14] is widely used for business model design, which is applicable to IoT/M2M services but does not consider their characteristics. Uchihira et al. proposed a method to analyze the possibilities and issues of M2M ser-vices [2]. They introduced backcasting from future M2M businesses to solve intertwined difficulties. They also pro-posed a concrete modeling procedure [3] based on this analytical method. Ide et al. proposed a lean design method-ology for IoT business models [15], where an extended BMC and a System Model Canvas are used. These proposed methods are designed mainly for a company's IoT service businesses, as does the BMC. However, in the modern global, competitive, and collaborative business environment, IoT services must be designed as a business ecosystem.

Regarding a business ecosystem of IoT services, Rong et al. proposed the 6C (Context, Cooperation, Construction, Configuration, Capability, and Change) framework for understanding the structure of an IoT business ecosystem [16]. However, the 6C framework does not include designing a platform leadership strategy [17] and a keystone strategy [18] in the global, competitive, and collaborative business environment. The open & closed strategy proposed by Ogawa [19] is highly suggestive in this environment. We introduce the open & closed strategy approach into the IoT service business ecosystem design method in this paper.

III. IOT SERVICE BUSINESS ECOSYSTEM DESIGN

Here, we present an IoT service business-ecosystem design method based on BMC [14] and the open & closed strategy [19]. BMC consists of 8 elements (Value Propositions, Customer Segments, Channels, Customer Relationships, Revenue Stream, Key Resources, Key Activities, Key Partners, and Cost Structure). Since BMC is a general tool and has no specific framework for designing IoT services, we add two templates ("SCAI Canvas" and "Open & Closed Strategy Canvas") to decompose and refine 4 important elements (Value Propositions and Key Resources, Key Activities, and Key Partners) of BMC. The SCAI canvas is used for classifying Value Propositions into two types from an IoT service viewpoint, then finding new values that make synergy effects among services. The Open & Closed Strategy Canvas is used for refining Key Resources, Key Activities, and Key Partners from the open & closed strategy viewpoint in a business ecosystem.

The proposed design method is an extended version of the M2M service modeling method, which was presented in PICMET2015 [3]. In the original version, an analyzing method for recognizing opportunities (SCAI Canvas) and difficulties (the difficulty map) of the target M2M services is integrated into the service modeling procedure. The new features of the proposed IoT service business-ecosystem design method include an additional step for designing the open & closed strategy using the Open & Closed Strategy Canvas. The original open & closed strategy provides a 2x3 matrix which specifies positioning of companies in a business ecosystem. However, this 2x3 matrix is ill-suited for specify distinctively three types of companies in open areas. The proposed Open & Closed Strategy Canvas can specify distinctively one closed area (enclosed core resources) and three open areas (global knowledge resource, global manufacturing resource, and global deployment resource). Especially, designing global manufacturing resources as open areas is our unique feature since the original open & closed strategy does not mention this explicitly. Ikawa and Inoue proposed "sourcing intelligence" [20] as knowledge about designing and utilizing global manufacturing resources, in addition to "market intelligence" and "technology intelligence." We think that sourcing intelligence is vital in manufacturing companies that struggle in the global business environment.

The details of the proposed IoT service design method are presented in Fig. 1, by focusing on the Open & Closed Strategy Canvas. Here, "service business design" refers to an abstract-level design and excludes the detailed system and software design.

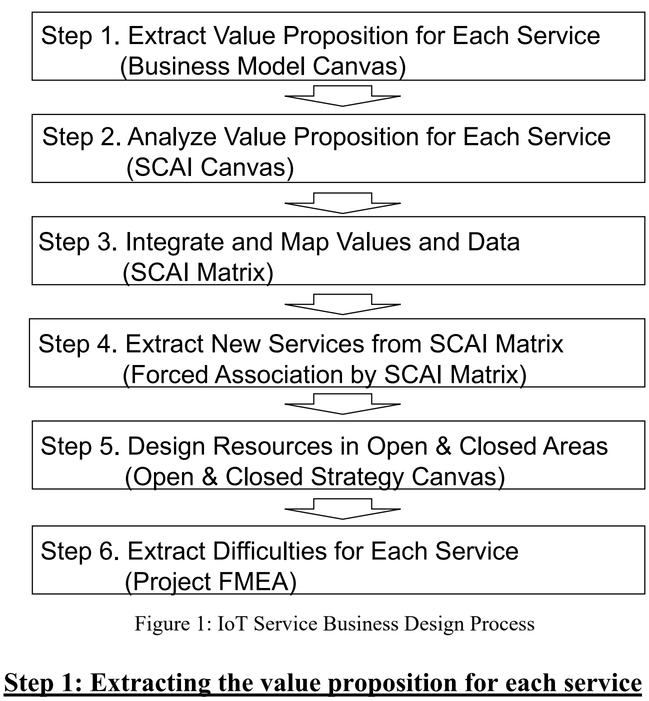

Figure 1: IoT Service Business Design Process

Step 1: Extracting the value proposition for each service

We start the service business design from the value propositions using the BMC [14]. A target IoT service business (e.g., smart home) may consist of several services (e.g., home security, home energy management, home healthcare, etc.). One canvas should be described for each service. The value propositions of each service are extracted considering customers, resources, business partners, and the revenue stream using the BMC.

Step 2: Analyzing the value proposition for each service

In this step, we analyze value propositions extracted in Step1 from IoT service viewpoint. According to the IoT service business analysis model (SCAI model; Share-Connect-Analyze-Identify) [2], the SCAI canvas is constructed for each value proposition by extracting five elements (share, connect, analyze, identify, and value). In the SCAI model, the IoT service value is classified into optimization value and identification value by data analysis and data identification, respectively. The optimization value is created by analyzing large volume data (i.e., "big data") from sensors using statistics and machine learning. The identification value is created by searching and identifying specific data over large coverage data. The SCAI model pays particular attention to the identification value, which tends to be ignored in other models. The SCAI canvas (Fig. 2) not only differentiates optimization value and identification value from the target value proposition but also identifies shared data required to create value and connection among these shared data. The optimization value and the identification value can be decomposed into 7 value types in detail. Table 1 shows these value types. For example, in case of a remote maintenance service of construction machines, proactive maintenance based on a failure prognostics model constructed by data analysis is a typical optimization value (prediction type) and a security system based on early detection of abnormal machine positions using GPS is a typical identification value (state identification type).

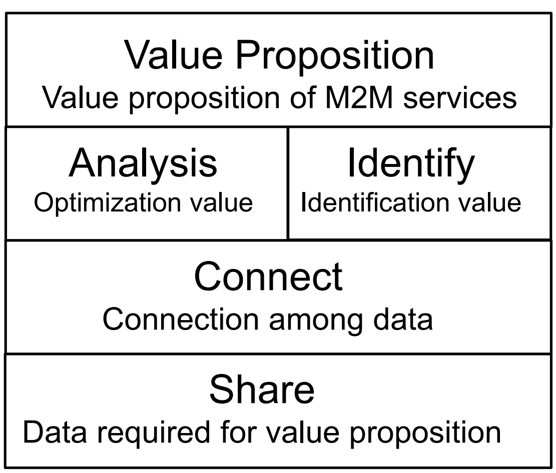

Figure 2: SCAI Canvas

TABLE 1: VALUE TYPES OF OPTIMIZATION AND IDENTIFICATION

	Value Type	Example (Remote Maintenance Case)
Optimization Value	Prediction	Failure prediction model
	Diagnosis	Failure diagnosis model
	Risk evaluation	Risk evaluation model in case of failure
	Recommendation	Maintenance timing recommendation
Identification Value	State identification	Abnormal state detection of machines
	Visualization	Visualization of all machine location data
	Decision making	Nearest maintenance personnel allocation

Step 3: Integrating and mapping values with data

In Step3 and Step4, we refine original value propositions and create new value propositions by using SCAI Canvas. First, we integrate the SCAI canvas items of all the proposed values and visualizes the relation between values and data using SCAI matrices I and II. Here, we can recognize all items from an integrated viewpoint and find synergy effects among them. In SCAI matrix I, the vertical axis shows all proposed values (optimization and identification values) and the horizontal axis shows value types and shared data; each matrix element indicates whether there are relations between the proposed values and the types of shared data. SCAI matrix I can comprehensively visualize the relation between the values and the data on the target service domain (Fig. 3).

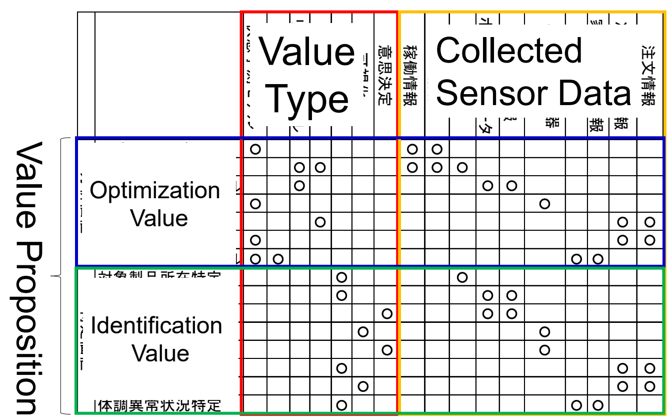

Figure 3: SCAI Matrix I

Step 4: Extracting new services from SCAI matrix

Using SCAI matrix II, new value propositions can be created by a forced association method. This forced association method prompts new ideas by associating corrected sensor data with each value type in the SCAI matrix II (Fig. 4). The created value propositions are reflected into the original business model canvases and refined business model canvases are generated. Note that these refinements of canvases are derived by integrating, visualizing, and comparing original canvases from synergy effect viewpoints.

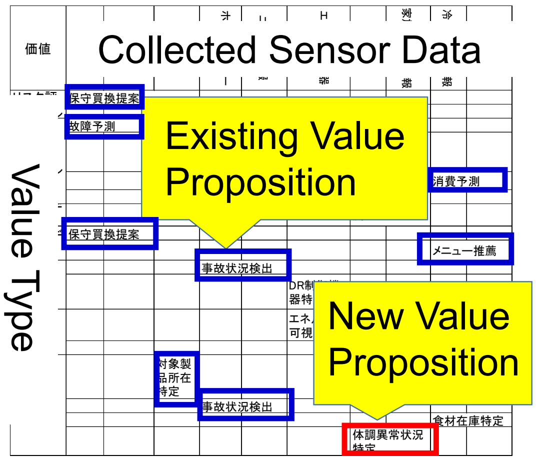

Figure 4: SCAI Matrix II

Step 5: Designing resources in open and closed areas

This step considers the business ecosystem for the refined business model canvases according to the open & closed strategy [19] since the BMC itself does not consider explicitly. Figure 5 shows our proposed framework for designing an IoT business ecosystem. In this framework, business resources can be classified into one enclosed core resource, in a closed area, and three resources, in open areas, as follows:

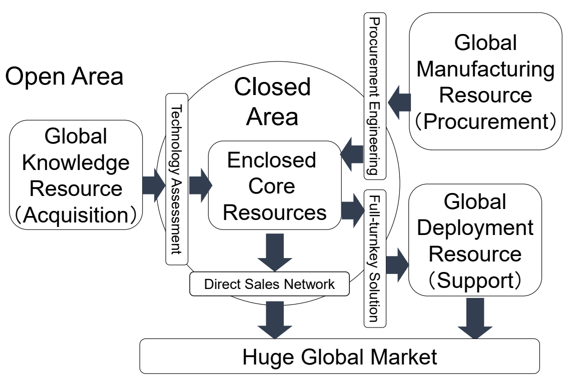

Figure 5: Open and Closed Strategy in the IoT Service Businesses Ecosystem

- Enclosed Core Resource
  A company's core resources including the core product and the production technologies, which are enclosed and guarded as intellectual properties.
- Global Knowledge Resource
  Knowledge resources (technologies and human resources) for strengthening the core resources are globally acquired through Mergers and Acquisitions (M&A), Connect and Develop (C&D), licensing, etc. Here, re-search personnel who can properly assess new technologies play an important role.
- Global Manufacturing Resource
  Manufacturing resources including Electronics Manufacturing Service (EMS) for making products and services based on the core resources are globally utilized. In this respect, it is important for the company to acquire a strong procurement engineering team. Inoue and Ikawa introduced the concept of "sourcing intelligence" and mentioned the important role of procurement engineering [19].
- Global Deployment Resource
  Partners who use the core resources as a platform and deploy final products and services into a huge global market are recognized for deploying these resources and supported by providing solutions based on the core resources. Here, full-turnkey solutions play an important role, which partners easily use without specialties and knowledge.

The interface between the closed area and an open area is important. In our framework, "technology assessment," "procurement engineering," and the "full-turnkey solution" work as the interface. This interface design is a key part of our IoT service design method, which includes strategies for managing intellectual property and standardization. In our method, an Open & Closed Strategy Canvas (Fig. 6) is used for this interface design, which corresponds to the Key Partner (KP), Key Activity (KA), and Key Resource (KR) of the BMC (Fig. 7).

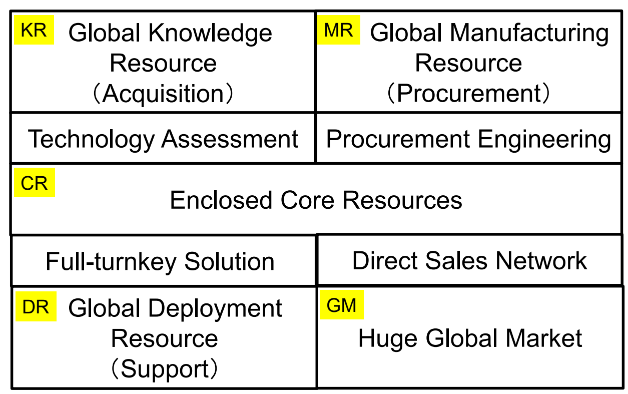

Figure 6: Open & Closed Strategy Canvas

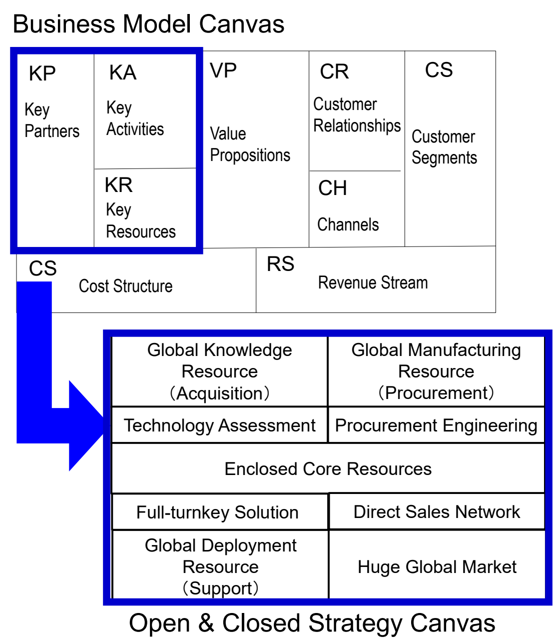

Figure 7: BMC and Open & Closed Strategy Canvas

Step 6: Extracting difficulties of M2M services

The expected concrete difficulties of the proposed services are extracted by a forced association method from the difficulty map proposed in [2]. The difficulty map is a fishbone chart representing IoT service business difficulties (pure technological difficulties, technology policy and management issues, difficulties in application and use cases, and business model issues). Typical difficulties include "fragmentation of solutions," "numerous incomplete standards," "revenue and risk sharing," and "locus of responsibility for unexpected failures." Then, risks and actions for these difficulties are clarified as a project failure mode and effect analysis (Project FMEA).

The proposed IoT service business-ecosystem design method has the following four characteristics:

a. Value proposition oriented.
Instead of starting from technologically feasible functions and spontaneous use cases, this method starts from the value propositions using the BMC.

b. Synergy effect among services utilizing the IoT platform.
This method pursues synergy effects by intersection of several IoT services using the SCAI matrices.

c. Forced association using a template based on domain knowledge.
Using several templates of the SCAI matrices, new services are created and concrete difficulties are extracted. These templates are designed based on an analysis of the IoT service business possibilities and issues.

d. Explicit consideration of open & closed strategy
In successful IoT services, forming a business ecosystem is an inevitable condition. Conventional business modeling and design methods including the BMC do not deal with the open & closed strategy. Instead, our method focuses on global manufacturing resources in addition to global knowledge resources and global deployment resources.

IV. APPLICATION TO SMART HOME AND SMART FACTORY

In order to demonstrate the effectiveness of the proposed method, we applied it to a smart home and a smart factory. Since a detailed explanation of a smart home example was provided in our previous paper [3], except for step 5 (Open & Closed Strategy Canvas), we show how to use the Open & Closed Strategy Canvas for designing resources in open and closed areas in the smart home. Here, we consider five IoT services: (1) home product remote maintenance, (2) home security, (3) home energy management, (4) home healthcare management, and (5) food delivery. If each service is developed and provided independently, it cannot overcome the problem of "fragmentation of solutions." On the other hand, if the five services are provided on the same IoT platform, the issue may be easier to overcome. However, our previous method [3] cannot explicitly consider the position, interface, and strategy of the target company among many stakeholders, which provide these services.

Figure 8 shows an Open & Closed Strategy Canvas of the smart home. A target company is an IoT platform provider for which five services are provided by partner companies. It constitutes an IoT service business eco-system, where a core resource of the target company is the IoT platform, which consists of software and sensors and is protected in a closed area. This platform software may be provided as cloud service (Platform as a Service). The target company acquires data analytics technology by M&A to strengthen the IoT platform software. The target company develops software by itself and makes contracts outsourcing the manufacturing of sensors, which are used in the smart home. Then, the target company provides the IoT platform (software and sensors) as a full-turnkey solution to partner service companies, including home security companies and electric transmission companies. In Fig. 8, we draw an Open & Closed Strategy Canvas in which the target company is an IoT platform provider. It is also possible to draw another Open & Closed Strategy Canvas in which the target company is a sensor manufacturer.

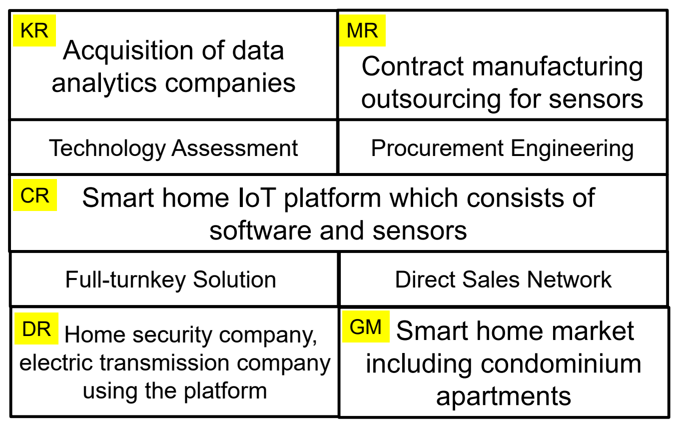

Figure 8: Open & Closed Canvas of Smart Home

As another example, we focus on a smart plant factory and consider two services: (1) automatic control and maintenance of factory equipment, and (2) flexible supply chain management. According to the procedure from Step 1 to Step 4 of the proposed method, the value propositions of the smart plant factory are derived as follows:

(1) Automatic control and maintenance service of factory equipment
- ✓ Stable harvesting
- ✓ Safety and quality control, and downtime reduction of factory equipment
- ✓ Externalization and retention of agriculture knowledge

(2) Flexible supply chain management
- ✓ Demand and supply adjustment among
- ✓ Market risk management and insurance which depend on weather

Then, an Open & Closed Strategy Canvas is designed as shown in Fig. 9. In this ecosystem, the core resource of the target company is the software platform for the plant factory and the supply chain management, and is protected in a closed area. This platform software may be provided as cloud service (SaaS: Software as a Service). The target company acquires agriculture knowledge from skilled farmers for strengthening the plant factory control software. The target company develops software by itself and makes cooperative selling agreements with other manufacturers for procuring sensors, robots, and facilities, which are used in the smart plant factory. Then, the target company provides the software platform for the plant factory control and supply chain management as a full-turnkey solution to partner service companies including agricultural producers and supermarket chains.

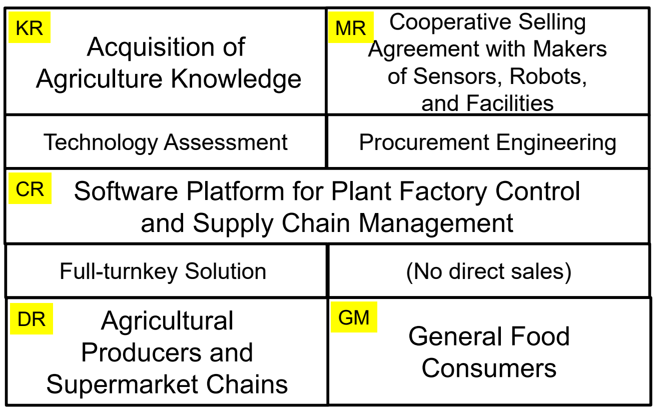

Figure 9: Open & Closed Strategy Canvas of Smart Plant Factory

V. DISCUSSION

Recently, several IoT-based initiatives have been activated, including Industrie 4.0 and Industrial Internet Consortium. These initiatives provide reference architectures [21, 22] for IoT platforms. However, they take a neutral stand and do not mention open & closed strategy, which is considered in each stakeholder behind closed doors.

Platform leadership is a well-known competitive strategy for attaining supremacy in an ecosystem [17]. It is not easy for companies to take a platform leadership. In these situations, the IoT service business design method may be helpful for these companies. The design method is not a magic wand, but it allows visualizing charts and canvas for stakeholders to share opportunities and difficulties of the IoT service businesses. One of the key factors resulting in the failure of IoT service businesses is communication, in the form of gaps and misunderstanding between stakeholders. The Open & Closed Strategy Canvas can be used not only by companies that want to be a platform leader but also by those wanting to use the platform.

Until now, many business-modeling methods have been proposed. The BMC is a typical method proposed by Osterwalder and Pigneur [14], and is used by our proposed method. Adner proposed the wide-lens toolbox for business ecosystem design [23], which is useful for recognizing risks in the business ecosystem and making a competitive strategy to overcome these risks. Compared with these general business-modeling methods, our method utilizes a domain (IoT communication) specific structure, which succeeds in promoting the forced association (SCAI matrix I and II).

Glova et.al. provided a business modeling method (e3-value method), which consists of 6 steps, for the Internet of Things environment [24]. This method guides business modeling from the value viewpoint, the business process viewpoint, and the information system viewpoint with a computer-aided design tool (e3-value editor). However, it lacks competitive strategy viewpoint, which our method provides by the Open & Closed Strategy Canvas. Table 2 shows a comparison table of the above business modeling and design methods. A unique and strong point of our proposed method compared with other methods is that it has design charts and procedure customized for IoT service business (SCAI Canvas) and featuring open and closed (competitive) strategy (Open & Closed Strategy Canvas).

After completing the business ecosystem design, service, system, and software design methods should be followed in the next step. Regarding service design, there are many design methods proposed, including Service CAD [25] and DFACE-SI [26].

TABLE 2: COMPARISON TABLE OF BUSINESS MODELING AND DESIGN METHODS

	Target Business	Ecosystem Consideration	Competitive Strategy	Design Charts	Design Procedure	Computer-aided Tool
Business Model Canvas [14]	General	-	-	++	++	+
Wide-lens Toolbox [23]	General	++	+++	+	+	-
e3-vale method [24]	IoT	+	-	++	++	++
Proposed Method	IoT	++	++	++	++	-

VI. CONCLUSION

Although there are high expectations for IoT service businesses from industries, it is not easy to monetize in real businesses in the global, competitive, and collaborative environment. An IoT service business design method considering the business ecosystem is required to bridge the gap between expectations and the current situation. In particular, considering the open & closed strategy in a business ecosystem, this paper introduces an Open & Closed Strategy Canvas into the business design method based on the business model canvas. In this paper, we use a smart home and a smart factory as examples. The proposed IoT service business design method has the following four characteristics: it is value proposition oriented, it considers IoT synergy effects, it includes forced association using the template, and it explicitly considers the open & closed strategy. These characteristics make this method unique. However, this is just a first step, and more refinements are required for the actual application of the method.

REFERENCES

[1] IDC; "Explosive Internet of Things Spending to Reach $1.7 Trillion in 2020, According to IDC," Retrieved 15/4/16 World Wide Web, http://www.idc.com/getdoc.jsp?containerId=prUS25658015

[2] Uchihira, N., et al.; "Service Innovation Structure Analysis for Recognizing Opportunities and Difficulties of M2M Businesses," in Papers presented at PICMET14, Kanazawa, pp.777-783, July 2014. (Extended version was published in Technology in Society, 43, pp.173-182, 2015.)

[3] Uchihira, N., Ishimatsu, H.; "Service modeling method for machine-to-machine businesses to overcome difficulties," in Papers presented at PICMET15, Portland, pp.1596-1602, Aug., 2015.

[4] Lawton, G.; "Machine-to-machine technology gears up for growth," IEEE Computer, Vo.37, No.9, pp.12-15, 2004.

[5] Lee, E. A.; "Cyber physical systems: Design challenges," In Object Oriented Real-Time Distributed Computing (ISORC), 2008 11th IEEE International Symposium on, pp. 363-369, 2008.

[6] Atzori, L., Iera, A., Morabito, G.; "The internet of things: A survey," Computer networks, Vol. 54, No. 15, pp.2787-2805, 2010.

[7] Wu, G., et al.; "M2M: From mobile to embedded internet," IEEE Communications Magazine, Vol.49, No.4, pp.36-43, 2011.

[8] Niyato, D., Xiao, L., Wang, P.; "Machine-to-machine communications for home energy management system in smart grid," IEEE Communications Magazine, Vol.49, No.4, pp. 53-59, 2011.

[9] Whitmore, A., Agarwal, A., Da Xu, L.; "The Internet of Things—A survey of topics and trends," Information Systems Frontiers, Vol. 17, No. 2, pp.261-274, 2015.

[10] Laya, A., Markendahl, J.; "The M2M Promise, What Could Make it Happen?," IEEE 14th International Symposium and Workshops on a World of Wireless, Mobile and Multimedia Networks (WoWMoM), pp.1-6, 2013.

[11] Markendahl, J., Laya, A.; "Business Challenges for Internet of Things: Findings from E-Home Care, Smart Access Control, Smart Cities and Homes," Proc. of the IMP 2013 Conference, Atlanta. 2013.

[12] Gonçalves, V., and Dobbelaere, P., "Business scenarios for machine-to-machine mobile applications," Mobile Business and 2010 Ninth Global Mobility Roundtable (ICMB-GMR), IEEE 2010 Ninth International Conference, pp.394-401, 2010.

[13] Leminen, S., et al.; "Towards iot ecosystems and business models," Internet of Things, Smart Spaces, and Next Generation Networking, Springer Berlin Heidelberg, pp.15-26, 2012.

[14] Osterwalder, A., Pigneur, Y.; "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers", Wiley, 2010.

[15] Ide, M., Kishida, T., Aoyama, M., Kikushima, Y.; "An IT-Driven Business Requirements Engineering Methodology," In Requirements Engineering, pp. 60-76, Springer Berlin Heidelberg, 2014.

[16] Rong, K., Hu, G., Lin, Y., Shi, Y., Guo, L.; "Understanding business ecosystem using a 6C framework in Internet-of-Things-based sectors," International Journal of Production Economics, 159, 41-55, 2015.

[17] Gawer, A., Cusumano, M.; "Platform leadership: How Intel, Microsoft, and Cisco drive industry innovation," Harvard Business School Press, 2002.

[18] Iansiti, M., Levien, R.; "The keystone advantage: what the new dynamics of business ecosystems mean for strategy, innovation, and sustainability," Harvard Business Press, 2004.

[19] Ogawa, K.; "Open & Close Strategy, 2nd edition (in Japanese)," Shoeisha, 2015.

[20] Inoue, K., Ikawa, Y.; "Sourcing Intelligence: The third intelligence for corporate strategy in the horizontal specialization era, " PICMET2012, 2012.

[21] VDI/VDE-Gesellschaft; "Reference Architecture Model Industrie 4.0 (RAMI4.0)," Status Report, ZVEI, July 2015.

[22] Industrial Internet Consortium; "Industrial internet reference architecture," Industrial Internet Consortium, Tech. Rep., June, 2015.

[23] Adner, R.; "The wide lens: A new strategy for innovation," Penguin UK, 2012.

[24] Glova, J., Sabol, T., Vajda, V.; "Business models for the internet of things environment," Procedia Economics and Finance, 15, 1122-1129, 2014.

[25] Hara, T., Arai, T., Shimomura, Y., Sakao, T.; "Service CAD system to integrate product and human activity for total value," CIRP Journal of Manufacturing Science and Technology, 1(4), 262-271, 2009.

[26] Uchihira, N., et al.; "Analysis and Design Methodology for Recognizing Opportunities and Difficulties for Product-based Services," Journal of Information Processing, Vol.16, pp.13-25, 2008.