Open innovation of consensus standard – cases of business model creation in ICT

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Abstract: Recently, technical standardisation has shifted from de facto to consensus standard in information communication technology (ICT). Moreover, the number of enterprises declaring patents in the standardisation process has increased. This paper verifies the 'strategy option of standards and patents' in consensus standardisation from the aspect of open innovation. Two case studies of Mitsubishi Electric, a multinational company in Japan, were presented. Both case studies use the consensus standardisation process and achieve open innovation. Closed innovation was assumed to be an initial innovation source in the consensus standardisation. Two open coupled innovation elements were introduced. A high-capability enterprise formed the outside institute that generate the innovation when the best innovation could not be procured from outside. Achieving an open innovation was then attempted.

Keywords: consensus standard; business model; open innovation; OI; information communication technology; ICT; standard setting organisation; SSO.

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1 Introduction

In information communication technology (ICT), standard setting organisation (SSO) standardisation is granted to interested enterprises, and the number of enterprises applying for it has been increasing. This standardisation is called the consensus standard (Shintaku and Etoh, 2008). A powerful enterprise constructs a business model tied to the

standard with its own patent to establish competitive dominance. This is different from the business model of the de facto standard in that a powerful enterprise is a market rival (Yamada, 1997; Shibata, 2000).

Based on the open innovation (OI) theory, this paper aims to clarify the business model construction process of a high-ability enterprise, search for an innovation element, acquire information about strategies and clarify whether to combine strategies.

2 Standard and patent

2.1 Standardisation trend

In 2000, de facto and de jure standards changed. The de facto standard decreased in the ICT field and the de jure standard increased (Table 1). A standard can be decided by a consortium or a forum in electronic and electric machine fields (Takeda, 2008). A de jure standard is decided after all increases are complete. The industrial structure of ICT has changed. The de jure standard increased and became powerful, based on the WTO/TBT agreement. The pre-eminence of the market of a public standard progressed by easing the system of international standardisation organisation (Etoh, 2007; Kajiura, 2005, 2008). Even if an enterprise acquires the de facto standard, because environment changes and market control is completed, it becomes impossible to construct a dominant competitive business model (Yamada, 1997; Shibata, 2000).

Table 1 Issued international standard by Japanese corporation proposal

Year	*De facto standard*	*De jure standard*	*Total*
1995–2000	158 (68.7%)	72 (31.3%)	230
2001–2006	93 (49. 5%)	95 (50. 5%)	188
Total	251	167	418

Source: Takeda (2008, p.44, Figure 3)

2.2 Consensus-based standard

Cargill (1989, 1997) discussed open systems and the ICT consortium. Jakobs (2000, 2006) studied standardisation decision processes and standardisation comprehensive bodies as part consensus standard studies. Kajiura (2005, 2010) and Shintaku and Etoh (2008) outlined the consortium from the standpoint of how international business treats standardisation. These studies detail the de jure standardisation process by a conference of interested parties in the consortium and forums. This conceptualisation is called the consensus standardisation. These studies discuss competition and strategy case studies on consensus standardisation introduced by the dominant business model. The model was constructed by de jure standardisation instead of de facto standardisation.

It is difficult for an enterprise to profit by merely considering consensus standards. For profit, construction of a dominant business model during and after the standardisation process is important. Two stages are suggested in the innovation of the business model; namely, ‘value creation’ and ‘value capture’. These will be explained in Section 3.

2.3 Relationship between standards and patents

Implications of standards and patents appear along with the trend of consensus standardisation. Many patents are declared in the de jure standardisation process (Table 2); suggesting that practicable new technology be standardised in ICT (Nawa, 1990; Etoh, 2007, 2008). This is because an enterprise can standardise its own patent with the intention of spreading and obtaining income by licensing it (Yamada, 2009). Thus, an enterprise constructs a competitive dominant business model by standardising the patents.

Table 2 Patent proposal in ITU-T standardisation

1983–1987	3.6 on average/year
1988–1992	15.4 on average/year
1993–1997	71.2 on average/year
1998–2002	119.4 on average/year
2003–2007	130.8 on average/year

Source: Yamada (2009, Figure 1)

3 Literature reviews

3.1 Open innovation

In contrast to a traditional vertically integrated model called closed innovation (CI) model, in an OI model, enterprises use knowledge and resources of other companies along with their own resources (Chesbrough, 2003, 2006; Chesbrough et al., 2006). OI results in minimum corporate internal activities and use of external resources, whereas CI uses knowledge and resources within an enterprise [Chesbrough, (2003), p.xxiv]. In such a background, the ICT industrial structure changes, although many companies use OI. Vertical integration enterprises that provide all knowledge and resource collapse, and the vertical and horizontal off-line systems and single business strategies advanced. As a result, knowledge and the resources of the enterprise are narrowed. Therefore, to procure knowledge and resources that they do not have, enterprises request for these external supplies. This increases the knowledge base of the enterprises (Christensen, 2006).

3.2 Innovation as a complete system

A business model refers to the competitive dominant business system that increases earnings. The significance of the business model is described from the viewpoint of OI (Chesbrough, 2006; Chesbrough and Crowther, 2006; Chesbrough and Garman, 2009; Enkel et al., 2009). Knowledge and resources that are either internal or external to an enterprise can be organically united. The business model can be successful by incorporating the functions of creating value (value creation) and linking to the economic value (value capture). The CI business model structure is limited and static. However, the probability of success of the business increases because an OI source can introduce directionality, knowledge and resources from the outside during various stages of the process [Chesbrough, (2006), p.3].

In this case, directionality denotes the movement of knowledge and resources from other companies. It is called the outbound type when knowledge and resources, such as patent clearance, are introduced from the inside of an enterprise to the outside. It is assumed to be an inbound type when it is introduced from the outside, such as patent purchases, to the inside of an enterprise. Furthermore, in recent years, joint ventures, alliances and both types of cooperation are concomitant. The relationship between collaborative organisations is called the coupled type, e.g., OI in an R&D business and open source development among enterprises and communities, universities and institutions (Enkel et al., 2009).

OI is achieved by uniting many innovation elements. Procuring proper knowledge and resources from other companies expands the choices of innovation elements for an enterprise. The enterprise can form a business model as a complete system by combining the best innovation elements (Chesbrough, 2006).

How does an enterprise acquire the necessary innovation elements? For this purpose, high corporate ability is necessary. An integrated corporate ability to form value creation and value capture in patent strategies is necessary to construct a competitive dominant business model (Chesbrough and Appleyard, 2007). Moreover, it is suggested that corporate ability that can conduct knowledge management, that is, the search for knowledge, be maintained, connected and used (Lichtenthaler and Lichtenthaler, 2009). Thus, it is assumed that corporate capability is necessary for the success of OI.

3.3 Patents and OI

A patent strategy is linked to the importance of OI research. Intellectual property rights, such as patents, significantly contribute to the formation of a successful OI business model and increasing earnings [Chesbrough, (2003), p.155]. Alternative patent strategies include a closed policy strategy that closes patents and limits users and an open policy strategy that opens the patent for many unspecified users. Value creation is achieved by standardising the patent technology in the open strategy. After spreading the technology, a standard is achieved as value capture, because the license fee is low or free. The time lag is such that value creation may tie to value capture. This certainly occurs for the consensus standard.

In contrast, it is possible to achieve value creation and value capture simultaneously without generating the time lag. This is because licensing agreement can be extensively negotiated for the closed policy strategy that is limited to interested parties. Moreover, value creation and capture are not likely to be generated at the time lag, because market control can be achieved at once for a strong de facto standard, which is typical of the CI model. This difference might be caused by the difference in standardisation at the occurrence time of value creation and value capture (Simcoe, 2006). Therefore, how to capture value after it is created becomes a problem in consensus standardisation for the enterprise. Thus, it is necessary to design value creation of which the final target is value capture for the enterprise (how to acquire the standard). Moreover, it is important to maintain the design of the business model, with the purpose of earnings, after the standard is acquired (Shintaku and Etoh, 2008).

Innovation is a result of an intentional activity of enterprises. The subject of the business model is a specified enterprise. Therefore, many researches of OI have limited to OI in the enterprise [Chesbrough et al., (2006), p.287]. However, in recent years, OI has been clarified to evolve in that an enterprise forms alliances or cooperates with an

outside agency and leads to the success of the business model [Chesbrough, (2006), p.166]. For instance, the role of an organisation, such as a university, an institution and a patent mediation enterprise, as an existing external innovation supply source of OI is pointed out (Chesbrough, 2003, 2006). This is believed to be an action, in that an enterprise procures the innovation element of an existing external agency and develops business.

Moreover, the strategy aimed at procuring an external innovation element for value creation and value capture for the enterprise is optional and can be taught as part of innovation task partitioning. Innovation task partitioning is a strategy that changes value creation and acquisition locations and attempts to increase earnings (Chesbrough, 2006).

4 Establishing hypotheses

In OI research, it is necessary to find the best external existing innovation. This is a point under discussion. Moreover, to achieve a competitive dominant OI business model, an enterprise might select innovation task partitioning. That is, the enterprise might select a business by introducing various innovation elements supplied from an external agency on the basis of the open policy [Chesbrough, (2006), p.2]. Moreover, OI shows that many external innovation elements are combined, and the competitive dominant business model is constructed as a complete system.

A high corporate ability is required for OI. However, what strategic behaviour does a high-ability enterprise select when an external innovation necessary to achieve OI does not exist? The author establishes the following hypotheses from this viewpoint and verifies them through corporate case studies.

Hypothesis 1 The enterprise tries to achieve OI by combining existing internal and external innovation elements and dominant competition.

Hypothesis 2 The enterprise tries to voluntarily establish an element when the best existing innovation element does not exist within and outside the enterprise to achieve OI.

5 Case studies

This case study is based on information and materials obtained from Mitsubishi Electric, CC-Link Partner Association (CLPA), etc. Mitsubishi Electric specialises in producing controllers and servo motors. Data comprise interviews conducted from September 2005 to September 2011 with ICT enterprise employees, a group that was contacted 23 times.

5.1 Standard and patent strategy in Mitsubishi Electric

Mitsubishi Electric has more than 40,000 patents through which it is currently making profit. Moreover, after the WTO/TBT agreement comes into effect, it will have a technological patent as an international standard. In 2001, Mitsubishi Electric established an intellectual property affairs department and an intellectual property centre directly under the control of the company president. These departments conduct business in relation to intellectual property in a system of 350 people.

Mitsubishi Electric has developed two patent strategies. First is to obtain earning by licensing agreement with other companies. It is a closed approach, because the agreement obstructs the entry of companies that are not part of this agreement by exercising exclusive right of patent use. Second is to acquire the international standard for spreading patented technologies. This is an open approach. Such a strategy aims to maximise enterprise value by intellectual property rights. This paper introduces two typical examples of the latter.

5.2 CC-Link

As part of ICT, factory automation (FA) field networks are currently widespread in the production plant to conserve wiring. CC-Link is one such network technology. The network is hierarchised by the information content that flows to the service space and the network (Table 3). Information is exchanged between network hierarchies. FA systems comprise sets of equipment that many enterprises offer. Therefore, the network is made open as public service, which benefits interested enterprises.

Table 3 FA network level

Level	*Network*	*Tool*
Upper	Information network	LAN, WAN
	Controller level network	FL-net
	Field level network	CC-Link, DeviceNet, PROFIBUS
Lower	Sensor level network	CC-Link/LT, CompoNet

Source: Data provided by Mitsubishi Electric Corporation

The field level network is the fastest network to control devices in the level (Table 3). This network comprises of a programmable logic controller (PLC) as the controller. The PLC substitutes the relay circuit and various field equipment that are coupled. This technology is an interface technical standard to which the international standard is enacted in the ISO and IEC. Examples of interface international standards include CC-Link, PROFIBUS and DeviceNet. Mitsubishi Electric in Japan has developed CC-Link and six companies superintend it; Siemens of Europe superintends PROFIBUS and Rockwell of the USA superintends DeviceNet. Market share is 40% in Asia, 42% in Europe and 25% in North America by each international standard (monetary-based results in fiscal year 2008).

The FA business of Mitsubishi Electric is classified into the industrial mechatronics business segment. In fiscal year 2010, this segment had a sales of 927 billion yen and an operating income of 100.1 billion yen; 22.3% of the sales revenue consists of 3 trillion 645 billion yen. After the Nagoya factory was established as a general-purpose electric motor mass production factory in 1924, the FA business began. The electric motor was a key model in the FA business until mid-1960. Mechatronics and the FA machine control business then became mainstays after the high growth period of Japan. Few enterprises can construct a complete system with in-house products. Thus, the FA industrial structure of has changed from the vertical integration type to the vertical and horizontal off-line systems. The CC-Link technology that couples element equipment of each company is open to the public.

5.2.1 Patent and standardisation

Mitsubishi Electric developed the network technology that connects a terminal robot with a controller, which is used in its own production line. It acquired a patent for it in four countries (network systems for a programmable controller: 3343036/Japan, 5896509/USA, 246906/Korea and 19650753/Germany). Mitsubishi Electric opened the basic company standard and released this programmable controller to the public in 1996.

In this background, the European and American markets have been occupied by their own network standards. Mitsubishi Electric tries to break through the situation with an industry-wide standard. In November 2000, the CLPA was established to spread this standard.

CLPA is responsible for managing the popular FA field network, CC-Link. Mitsubishi Electric became a leader by opening its own technology to the public with the help of six member companies: Mitsubishi Electric, NEC, IDEC, Cognex, 3M and Digital. The joining members originally comprised 134 companies. As of fiscal year 2010, CLPA now comprises 1,500 members, with 1,130 products and eight million nodes (number of connections). The share of CC-Link in Asia is the largest (40%).

Members enjoy privileges such as obtaining licensing technologies and specifications connected directly with the business and conducting the obligatory conformance examination for a fee. The conformance examination is an authentication system that is mandatory for CC-Link products.

The spread of CC-Link as an international standard was attempted in foreign countries. Therefore, CLPA proposed the standard to Semiconductor Equipment and Material International (SEMI, USA), a worldwide semiconductor fabrication equipment group comprising 2,500 companies. SEMI establishes the networking protocol for semiconductor fabrication equipment. CC-Link was adopted as an industry standard through the examination in May 2001 (SEMI standard E54.12).

In addition, CLPA advanced the de jure standardisation of CC-Link. The international standard of the FA network comprises two forms. The first is the procedure and the data format exchanged between equipment, that is, protocol specification. The second is the specification of the connected equipment (maker and support point, etc.), that is, device profile. The former was standardised as IEC61158 in IEC/SC65C in December 2007, and the latter was standardised as ISO15745-5 in ISO/TC184 SC5 in January 2007. The patent of Mitsubishi Electric that relates to these standards is open to the public for free.

5.2.2 Business building

CLPA expansion has contributed to the development of the FA business of Mitsubishi Electric. Competitors such as Siemens and Rockwell International were skilled in the business of vertical integration and had many product varieties. Thus, their complete system sales were large. However, Mitsubishi Electric specialised in principal occupation equipment sales, such as controllers and servo motors (high-speed, efficient driving force), and could not achieve systematic sales with a high additional value. In addition, after the FA networks in Europe and USA named PROFIBUS and DeviceNet were open to the public, Mitsubishi Electric found itself in a difficult position. It wanted to open CC-Link to the public, standardise it as a company standard and spread it. Consequently, it established CLPA.

When network users such as vendors unite the complete system, programmable controllers, such as sequencers the advantage of Mitsubishi Electric and servo motors will be widely adopted. Thus, the spread and the expansion of CC-Link will increase the sales volume of Mitsubishi Electric equipment. Sales in the industrial mechatronics field for fiscal year 2010 increased by 26% in China according to Mitsubishi Electric (927.9 billion yen). About 25% of the entire sales (230 billion yen) are obtained from CC-Link.

5.3 Patent pool: MPEG-2

A patent pool is a method of establishing the license proprietary of a company so that a licenser manages patents collectively, acts as a mediator, collects license fees from licensees and distributes suitable licenses to the licensees. Mitsubishi Electric relates has the following patent pools:

1 MPEG-2 licenses are managed by MPEG LA, whose 22 licenser companies are proprietors of the compression technique standard of dynamic scenes.

2 DVD-6C is the DVD technological patent management company comprising seven companies, including Mitsubishi Electric, Hitachi and IBM. It manages patent of products classified into 14 categories.

3 3G Licensing Company manages WCDMA and future public land mobile telecommunication systems. WCDMA is a mobile communication standard for mass multimedia transmission for communication over mobile networks. Future public land mobile telecommunication systems is a radio access method.

4 Mitsubishi Electric is currently developing power amplifiers. ARIB is the international standard for digital broadcasting. The patent is managed by ULDAGE Ltd., which was established by Mitsubishi Electric. It comprises 15 companies including Fujitsu, Sharp and Sony.

Thus, Mitsubishi Electric aims to prevent and reduce losses in license fee collection by using patent pools and it is executing certain patent management processes. In this paper, the typical patent MPEG-2 is described in detail.

5.3.1 Patent

In the first half of the 1980s, Mitsubishi Electric worked on animation compression encoding technology. This was an important time for electronic technology products, with the development of a technology H.261 that preserved and transmitted dynamic scenes related to images. This technology was first introduced at a business TV conference system and was later developed into a business and patented (patent 2100607). It improves deterioration in images because of image compression and transmission. H.264 (patent 2128624th) is built on Moving Picture Experts Group (MPEG). However, its disadvantages include low resolution compared with the image of a standard television signal. These technologies can regenerate signals to the desired level.

Mitsubishi Electric developed H.264 as a compression encoding technology for dynamic scenes, with resolutions equal to that of standard television signals. This was

developed into a business by mid-1990s and was used for compression encoding of ground analogue television signals. Furthermore, it was adopted by many television broadcasting stations.

Mitsubishi Electric's main focus is encoding technologies, and it has acquired about 150 patents related to MPEG-2 and MPEG-2 systems.

5.3.2 Standardisation

Owing to full-scale digital broadcasting, the need for coding technologies in satellite, terrestrial and cable broadcasting as well as DVDs has increased. International standardisation began with the adoption of MPEG-2 by ISO/IEC JTC1 for video encoding technology in 1988. MPEG is originally used as a technical term in the Working Group of ISO/IEC JTC1 (Belong to SC29 now). The enterprise and ITU-T, SSO of international communication standardisation, participated in the standardisation.

Many Japanese companies that developed video encoding technologies, such as Mitsubishi Electric, Fujitsu, Panasonic and Sony, participated in standardisation.

MPEG-1 that made video CDs an application in 1993 was no longer considered as a standard in 1994, and MPEG-2 was approved as ISO/IEC 13818 in 1994. The related technologies, MPEG-4 and MPEG-7, are also advanced to standardise. MPEG-2 has the widest reach among all MPEG standards. It can be used with various media.

5.3.3 Business building

The MPEG committee began examining the strategy that managed important patents collectively in 1993, because many enterprises included MPEG-2 as the patent technology. Thus, the MPEG IPR Working Group was established, and the proprietary company decided to assume the patent pool. It selected 27 essential patents. The patent holders are Columbia University, Fujitsu, General Instrument, Lucent (AT&T at that time), Matsushita Electric Industrial Co. Ltd., Philips, Scientific Atlanta, Sony and Mitsubishi Electric. Furthermore, it decided to impose a fixed royalty on final products at a low rate [reasonable and non-discriminatory tariff (RAND)]. For instance, it imposed a royalty of four dollars in DVD1 packing (the market price was about 200 dollars) at the end of 2001. Other application products and tariffs include DVD players for consumers, encoder/decoders (4 dollars) for computers (6 dollars) and DVD rentals (40 dollars).

When MPEG LA was established, there was a possibility that it collided with the Antimonopoly Law. However, the justice authority ruled that it did not. The licenser of MPEG-2 (MPEG LA) established the patent pool in 1997, with the first members being Mitsubishi Electric, Columbia University, Fujitsu, General Instrument, Matsushita Electric Industrial Co. Ltd, Philips, Scientific Atlanta and Sony. Eight companies invested jointly in the licensed proprietary company in the USA.

The proprietary companies receive patent consignments from a licenser, collect the royalty from licensees, i.e., providers, and pay the distribution fee to the licenser according to the number of patent possessions. The essential patent standard of the patent pool is limited to essential technology patents, and commercial patents are excluded. Despite such restrictions, initially, the patent pool of eight companies owned 27 essential patents. By 2008, the pool expanded to 22 companies and 789 patents.

Mitsubishi Electric had 138 essential patents registered in the patent pool, and their share in the patent pool was high (as of April 2011, including the lapse cases). The royalty income acquired by Mitsubishi Electric so far is not made public. However, royalties of 10 billion yen or more were collected in 2006, according to trial calculations obtained by provisionally calculating only DVD sales in the US market (Yamada, 2009). Mitsubishi Electric is presumed to obtain an enormous royalty.

6 Analysis of innovation strategy

6.1 Framework

In the OI research, the contents of a dominant competitive business model are clarified on the basis value creation and value capture of innovation. The author clarifies the contents of value creation and value capture of innovation in the business model construction process, referring to early research reviews. Therefore, the framework of the following analyses is set.

Innovation is achieved by creative endeavours that create value from ideas and knowledge and value capture that ties it to the economic value. Consensus standardisation is a process where the enterprise confers SSO standardisation on the interested party and the standard is settled. Various ideas and knowledge are accumulated in this process, which is considered to be the value creation process of innovation. The economic value (earnings) does not necessarily materialise the innovation from the previous research in this process. It is realised in a subsequent process, and the innovation element of value capture is found.

How are idea and knowledge introduced and emitted in value creation and value capture? In OI research, the case that might be emitted from the directionality of idea and knowledge, that is, from an external enterprise and from outside an enterprise in within it, has been discovered. To clarify directionality, the analysis from such an aspect will be needed in consensus standardisation.

Vertical integration, CIs of the domestic production type and OIs of the vertical off-line type use the idea and knowledge of other companies. The creation and development of innovation might not be necessarily achieved in the same organisation and may be achieved because of the relationships between organisations. Various internal and external innovation elements are introduced. Furthermore, the process combines and constructs the business model (innovation task partitioning). Therefore, it is necessary to focus on value creation and value capture in consensus standardisation and clarify the role of innovation task partitioning.

Finally, the idea and knowledge might be opened to the public (open policy), hidden or may not be open to the public (closed policy). How do open and closed policies influence value creation and value capture in consensus standardisation?

Table 4 Framework of innovation strategy

1. Process	*2. Innovation type*	*3. Direction*	*4. Policy*
Value creation	OI	Outbound	Open policy
Value capture	CI	Inbound	Closed policy

6.2 CC-Link

6.2.1 Value creation

Value creation of innovation is found in the R&D process and patent development of network technologies. Next, it is found in the process where Mitsubishi Electric played an important role in CLPA establishment and in the process of the international standardisation by CLPA. That is, it is possible to detect value creation in a series of processes until the consensus standard is approved. The network technology was developed first for in-house use in Mitsubishi Electric and then converted into a patent. The innovation at that time was CI. Thus, it was an exclusive closed policy that held fast. However, to oppose system integrators in Europe and America and get rid of principal occupation vendors of single goods products, Mitsubishi Electric selected the open policy and opened this technology to the public for free.

Mitsubishi Electric was centred as the partner. The external agency, CLPA, was established by a strategy involving five Japanese companies. CLPA played the role of an organisation that spreads technology as well as SSO. Consensus standardisation has advanced in CLPA on the basis of CC-Link technology. CC-Link was adopted as an industry standard by SEMI to develop a standard proposal from CLPA to ISO and IEC. This led to international standardisation. These series of processes are OI, based on the open policy.

The relationship between collaborative organisations, such as technology exchange, information interchange and chance of cooperation chance, is found in the CLPA member enterprises. Thus, the coupled type is formed for directionality of innovation. Moreover, value creation is considered to be innovation task partitioning to be performed by CLPA as an external agency.

Table 5 Value creation of the CC-Link

Process	R&D, patent	CLPA establishment	Standardisation
Contents	FA network technology development and patent (internal use only)	CLPA was established with six companies intending to spread CC-Link.	CLPA proposed. The industry standard (SEMI) and international could be ascertained (ISO, IEC).
Innovation type	CI	OI	OI
Innovation policy	Closed policy	Open policy	Open policy
Innovation direction	-	Coupled type	Coupled type

6.2.2 Value capture

Value capture of CC-Link has benefited not only Mitsubishi Electric but also CLPA members. Mitsubishi Electric first succeeded in spreading CC-Link through CLPA activities. Consequently, it expanded the FA business. Many Mitsubishi Electric product groups (controllers and servo motors) were adopted and introduced by vendors and consumers. Regarding the network technology system, the rival companies in Europe and America are skilled in the vertical integration type system configuration, and a strong CI is maintained. To oppose this configuration, Mitsubishi Electric established the vertical

and horizontal distribution type system configurations in cooperation with the CLPA member group. This is judged to be OI.

CC-Link has resulted in collaborative benefits to user enterprises by offering a high-speed, high-precision communication network technology. Consequently, the user enterprises consist of 1,500 companies or more (fiscal year 2010). Such a process denotes OI, based on the open policy. The directionality of innovation is a collaborative coupled type between interested organisations.

Table 6 Value capture of CC-Link

Process	Horizontal and vertical distribution type system configurations are achieved and FA business is expanded
Content	Spread of CC-Link by CLPA activity and sales expansion of products (controllers, servo motors, etc.)
Innovation type	OI
Policy	Open policy
Directionality	Coupled type

6.3 MPEG-2

6.3.1 Value creation

Value creation of innovation is found in the process of R&D, patent development and consensus standardisation of MPEG-2. A related technology is an animation compression encoding technology, which Mitsubishi Electric first used as an in-house product. This H.261 technology was competitive and developed into a patent. It was also used to develop business, and later, additional features were developed for many related technologies. Currently, Mitsubishi Electric is achieving CI based on the closed policy.

However, MPEG-2 resulted in an unexpected development for Mitsubishi Electric. The ISO/IEC JTC1MPEG committee decided to make this technology as an international standard having a large impact. Many related patent enterprises are expected to participate in consensus standardisation. Mitsubishi Electric patents were recognised as an essential international standard patents (ISO/IEC 13818). This technology was standardised by SSO on the basis of the open policy, and OI progressed. This denotes the collaborative innovation formation process of making SSO a stage, centring the patent possession enterprise and building the patent technology into the standard by the conference (Simcoe, 2006). The directionality of innovation is the coupled type.

Table 7 Value creation of MPEG-2

Process	R&D and patent development	Standardisation
Content	It develops a product for in-house use (H.261)	It participates in MPEG-2 WG of ISO/IEC and participates in standardisation
Innovation type	CI	OI
Policy	Closed policy	Open policy
Directionality	-	Coupled type

6.3.2 Value capture

MPEG-2 became an international standard as ISO/IEC 13818 in 1995. The MPEG committee did not open the essential patent to the public free of charge and selected RAND. Eight essential patent possession enterprises and organisations established a proprietary company (MPEG LA), which collectively managed 27 patents. Mitsubishi Electric actively participated in the establishment of the proprietary company and invested establishment capital. The proprietary company's patent pool develops OI based on the open policy. The patent pool has the advantage of cost reduction in the license fee collection and prevention of loss for the licenser. Licensees can enjoy a low license fee. Both the licensor and licensee enjoy benefits. The directionality of the innovation is a coupled type.

Mitsubishi Electric introduced 138 patents into the patent pool. This is considered a strategy that strengthens the business model of the standard and the patent. Mitsubishi Electric has succeeded in enhancing OI and has achieved economic gains for the long term.

Table 8 Value capture of MPEG-2

Process	Management of patent business	Enhancing of patent business
Content	Patent pool: collection and management of license fee by establishment of MPEG LA	Additional development of MPEG-2 essential patent
Innovation type	OI	OI
Policy	Open policy	Open policy
Directionality	Coupled type	Coupled type

7 Findings

7.1 Dynamism of value creation and value capture

7.1.1 Value creation

Figures 1 and 2 show how OI and CI found that value creation and capture processes progressed at corporate and institution levels. The innovations in the first stage of value creation process of the two cases are R&D and patent development. Because the use has been limited to in-house products, this is considered to be CI.

Mitsubishi Electric aims at new market creation by standardising and spreading a technology and plans to expand its share. To oppose existing European and US power, consensus standardisation with SSO is selected as a strategy for speeding CC-Link. Moreover, consensus standardisation with the SSO is selected for MPEG-2 by the consensus of the industry and the policy of ISO/IEC. Then value creation of innovation changes to OI, in which CI at a corporate level is achieved with SSO (institution level).

7.1.2 External innovation procurement from an organisation

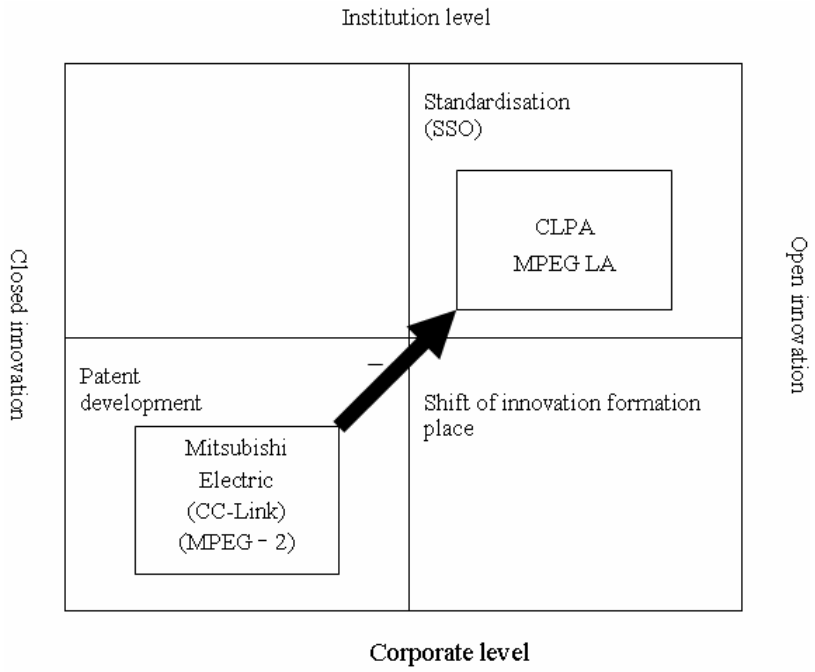
Innovation methods of making the external agency, the SSO, as a source are required. Consensus standardisation is a process in which the interested enterprises progress

standardisation by the conference, and the technology, the idea and knowledge are exchanged extensively between the enterprises. The standard decided is such that the final result and the innovations are been exchanged among interested parties on the basis of the open policy as per the consensus standardisation process. Thus, the network and various innovations are formed and used. Therefore, neither value creation nor value capture necessarily occurs in the same organisation. Hence, many parties may exchange innovations (innovation task partitioning). This is a feature of a collaborative coupled type OI in which innovations are freely introduced and emitted.

SSO is a mediating organisation that plays an important role in OI achievement. Mitsubishi Electric first participated in international standardisation as soon as the MPEG committee founded SSO. It then succeeded in developing its own technology, an essential patent, and therefore, it achieved OI for MPEG-2.

Mitsubishi Electric voluntarily initiated with other enterprises and established CLPA for CC-Link spread. Mitsubishi Electric advanced the industry standard and international standardisation and achieved OI. In addition, it procures an external innovation in the strategy and achieves OI.

Figure 1 Value creation positioning



7.2 Value capture

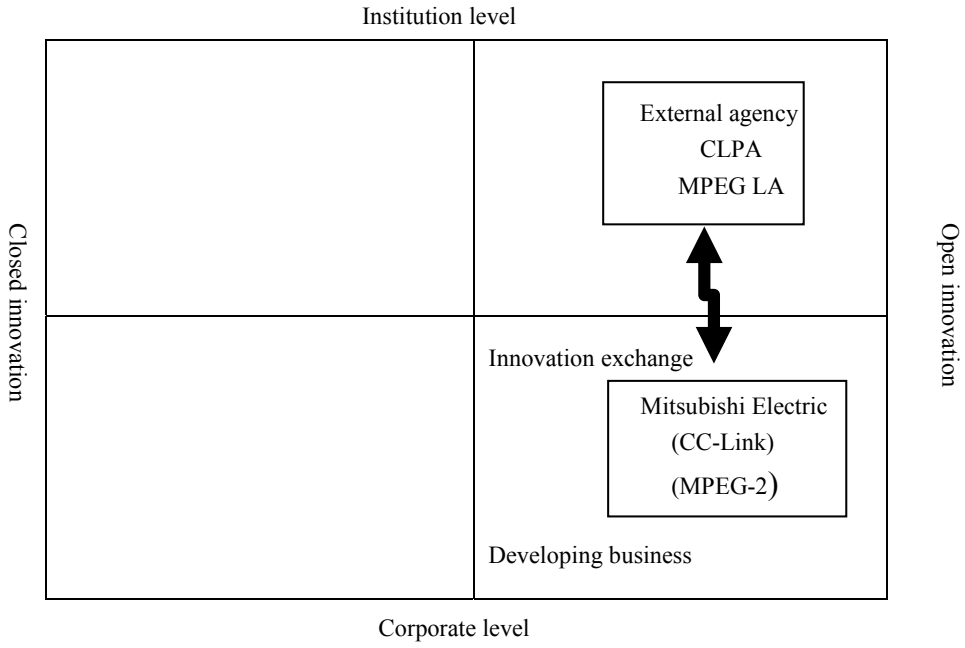
7.2.1 Function of external agency

Value capture converts the created innovation to its economic value (earnings). How does Mitsubishi Electric attempt value capture by the consensus standardisation

technology? It conducts the FA business itself. Thus, value capture is obtained at a corporate level. However, the external agency, CLPA, serves an important function in the value creation phase. CLPA contributes to the spread of CC-Link that opposes the FA industry of Europe and America, achieving a top share in Asia. When a member enterprise, that is, the vendor, uses CC-Link and the FA system is introduced information exchange and technical assistance with other vendor member enterprises in CLPA are obtained. Moreover, Mitsubishi Electric products are a result of the development enterprise of CC-Link at the FA system construction (controllers and servo motors). A collaborative exchange of the innovations is obtained between the members through CLPA. Thus, CLPA functions as a place for innovation exchanges of FA businesses to contribute to value capture. This denotes OI, which is based on the open policy. Directionality is a collaborative coupled type between the interested enterprises.

Furthermore, OI of value capture has advanced similarly for MPEG-2 at the external agency level of the patent management company MPEG LA. The licenser enterprises, such as Mitsubishi Electric, entrust to MPEG LA the tasks of contract management with the licensee, which was originally its responsibility, as well as negotiation and collection of the license fee. Hence, they achieve cost reduction. They can also enjoy the advantage of the patent technology by making MPEG LA a window for licensees and paying a low rate and a reasonable license fee. This is the process by which the exchange of collaborative innovations, that is, OI of the coupled type is achieved for both licensors and licensees. In addition, Mitsubishi Electric has developed the essential patent related to MPEG-2 and has succeeded in extending the business model.

Figure 2 Value capture positioning



7.3 Examination of hypotheses

Hypothesis 1 The enterprise tries to achieve OI by combining existing internal and external innovation elements and dominant competition.

In two cases, the enterprise converts to OI along with consensus standardisation, although it follows CI technology type at first value creation. The external agency develops a successful business for value capture, which is considered to be OI. In the entire process, various innovation elements are introduced properly and they are emitted, and OI as a complete system is constructed. Therefore, Hypothesis 1 is supported.

Hypothesis 2 The enterprise tries to voluntarily establish an element when the best existing innovation element does not exist within and outside the enterprise to achieve OI.

Mitsubishi Electric established CLPA to initiate and function as an SSO, advance standardisation and achieve OI for CC-Link by the value creation phase. In the value capture phase, Mitsubishi Electric uses CLPA for technology diffusion, increases sales of its own products and achieves OI in the FA business. Mitsubishi Electric jointly established MPEG LA as a patent management organisation, and it is achieving OI for MPEG-2. Hypothesis 2 is supported from the achievement of OI as a result of acquiring the best innovation element.

8 Conclusions

This paper verified the case of Mitsubishi Electric based on the viewpoint of OI and clarified the feature of the business model that the consensus standard constructed. To accomplish this, first, the enterprise assumed CI to be a source and introduced the best OI elements in value creation and value capture phases. It achieved the entire OI. Moreover, by using an external agency (SSO) as a generator for value creation and capture phases, it became clear that OI is successful by introducing or emitting knowledge and resources outside from many routes in the process. Second, the consensus standard of OI differed from the de facto standard of the CI model. It was clarified that a collaborative relationship existed between the enterprises. The coupled type by the open policy functioned effectively. Third, to achieve the best OI, the enterprise voluntarily established an external agency from a strategic standpoint. This only shows that the enterprise with a high ability simply searches for and does not introduce an external innovation. Such an enterprise voluntarily forms the source of the best innovation and procures it. Thus, it was clarified that the enterprise has the ability to construct the OI of the complete system.

The limitations and the future tasks of this study are now illustrated. It was clarified that OI was achieved at the institution level. However, a detailed content of the institution was not examined. Moreover, the form of institutions vary such as consortium, forums and the international standardisation organisation, Thus, forms of institutions should be examined from the viewpoints of function, structure and interpretation of OI in the future. For this purpose, research on mediating organisations and transitional structures progressed in organisational theory will be a reference (Yamada, 1993). Moreover, the external environments of the policy and the market structure that influences the formation

of OI were not examined in this study. It is necessary to deepen OI research in the future from such viewpoints.

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References

Cargill, C.F. (1989) *Information Technology Standardization*, Digital Press, Bedford, MA.

Cargill, C.F. (1997) *Open Systems*, Prentice Hall, New Jersey.

Chesbrough, H. (2003) *Open Business Models*, Harvard Business School Press, Boston, MA.

Chesbrough, H. (2006) *Open Business Models*, Harvard Business School Publishing, Boston, MA.

Chesbrough, H., Vanhaverbeke, W. and West, J. (Eds.) (2006) *Open Innovation, Researching a New Paradigm*, Oxford University Press, New York.

Chesbrough, H.W. and Appleyard, M.M. (2007) 'Open innovation and strategy', *California Management Review*, Vol. 50, No. 1, pp.57–76.

Chesbrough, H.W. and Crowther, A.K. (2006) 'Beyond high tech: early adopters of open innovation in other Industries', *R and D Management*, Vol. 36, No. 3, pp.229–236.

Chesbrough, H.W. and Garman, A.R. (2009) 'How open innovation can help you cope in lean times', *Harvard Business Review*, December, Vol. 87, No. 12, pp.68–76.

Christensen, J.F. (2006) 'Whither core competency for the large corporation in an open innovation world?', in Chesbrough, H., Vanhaverbeke, W. and West, J. (Eds.): *Open Innovation, Researching a New Paradigm*, pp.35–61, Oxford University Press, New York.

Enkel, E., Gassmann, O. and Chesbrough, H. (2009) 'Open R and D and open innovation: exploring the phenomenon', *R and D Management*, Vol. 39, No. 4, pp.311–316.

Etoh, M. (2007) 'IPR and standardisation (Japanese)', in Kajiura, M. (Ed.): *International Business and Technological Standards*, pp.182–229, Bunshindo, Tokyo.

Etoh, M. (2008) 'What is consensus-based standards (Japanese)', in Shintaku, J. and Etoh, M. (Eds.): *Strategic Use of Consensus-based Standards (Japanese)*, pp.1–35, Nihon Keizai Shinbunsya Publishing, Tokyo.

Jakobs, K. (Ed.) (2000) *Information Technology Standards and Standardization: A Global Perspective*, Idea Group Publishing, New York.

Jakobs, K. (Ed.) (2006) *Advanced Topics in Information Technology Standards and Standardization Research*, Idea Group Publishing, New York.

Kajiura, M. (2005) *IT Standard (Japanese)*, Tokyo, Bunshindo.

Kajiura, M. (2008) 'ICT international standard consortia (Japanese)', *JAFTAB Journal*, No. 47, pp.156–166.

Kajiura, M. (2010) 'The strategic consortia movement in standardization', *International Journal of Manufacturing Technology and Management*, Vol. 21, Nos. 3/4, pp.324–339.

Lichtenthaler, U. and Lichtenthaler, E. (2009) 'A capability-based framework for open innovation: complementing absorptive capacity', *Journal of Management Studies*, Vol. 46, No. 8, pp.1315–1338.

Nawa, K. (1990) *Technological Standards Versus IPR (Japanese)*, Cyuokoron, Tokyo.

Shibata, T. (2000) 'De fact standard strategy in the age of multimedia (Japanese)', in Sintaku, J., Kai, Y. and Shibata, T. (Eds.): *Essence of Defacto Standard*, pp.41–54, Yuhikaku, Tokyo.

Shintaku, J. and Etoh, M. (Eds.) (2008) *Strategic Use of Consensus based Standards (Japanese)*, Ch. 1, 3, 5, Nihon Keizai Shinbunsha, Tokyo.

Simcoe, T.S. (2006) 'Open standards and intellectual property rights', in Chesbrough, H., Vanhaverbeke, W. and West, J. (Eds.): *Open Innovation, Researching a New Paradigm*, pp.161–183, Oxford University Press, New York.

Takeda, S. (2008) 'A study on the formation of standards through global competition by multinationals (Japanese)', *MNE Academy Journal*, No. 1, pp.31–48.

Yamada, H. (1993) *Organization Relation (Japanese)*, Ch. 2, Yuhikaku, Tokyo.

Yamada, H. (1997) *Competitive Strategies for De fact Standard*, Japanese, Nihon Keizai Shinbunsha, Tokyo.

Yamada, H. (2009) 'Standardisation and IPR strategy in telecommunication industry (Japanese)', *Chizai Kanri*, Vol. 59 No. 3, pp.263–271.