Open innovation in the IT strategic business models of standards and patents

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Abstract: The intellectual property rights of information technology (IT) patents conforming to international standards have recently been used by international businesses as powerful IT companies' patents and standards have increasingly been developed to those standards. Thus, the relationship among technology, patents and standards is closer than that in the past. The standardisation trend has changed from the previous model of one powerful firm creating a de facto standard to the current consensus-based (de jure) standardisation models involving an industry forum or consortium. This study describes the IT standardisation trend in patents and explains the business model strategies for standards and patents. In the current business model, open innovation has shifted from the corporate level to the institutional organisation level as demonstrated in case studies.

Keywords: business model; standard; patent; open innovation.

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1 Introduction

The global business world is transforming in the 21st century. The globalisation of information technology (IT) business did not advance early in its growth because of different national regulatory controls and standards. However, after the WTO/TBT agreement, the factors limited free trade and foreign direct investment, and hence are being eliminated. Similarly, intellectual property (IP) rights have become an element of the global IT business with multinational companies protecting their rights in the exploitation of their technology through patents, which enable the enterprise to realise a

profit from transferring technology usage rights to overseas companies. Furthermore, firms have recently implemented the patent strategy of directly relating the patent to an international industry standard, resulting in closer relationships between standards and the related patented technologies (Greenstein and Stango, 2007; Etoh, 2008; Kajiura, 2010). The enterprise essentially privatises the industry standard and open innovation rises from the individual corporate level to the institutional organisation level (Ollila and Elimquist, 2011; Lichtenthaler, 2011).

In this paper, one business model of a strategy for relating a standard and a patent is described from the analytical perspective of open innovation (Chesbrough, 2003, 2006). The business model is described from the viewpoint of open innovation (Chesbrough, 2006; Chesbrough and Crowther, 2006; Chesbrough and Appleyard, 2007; Chesbrough and Garman, 2009; Enkel et al., 2009).

2 Changes in standards

Recently, the change in new IT technology has been remarkable. The development of a new technology accelerates and it enters the market by offshoot. The number of adaptations and modifications increase along with it and the content changes (Nawa, 1990; Yamada, 1997; Fujino and Etoh, 2009). Typical changes to the standard include the following.

2.1 Quantitative expansion

The number of document pages of special content was 22,570 in 1985 and the number of documents that related to the standard agreed upon in the international standardisation organisation increased thereafter [Nawa, (1990), p.14]. The ISO document numbered 35,397 pages in 1991 and 54,787 pages in 1995, ultimately reaching 72,385 pages in 2000 (Eicher, 2001).

2.2 Qualitative expansion

Many types of standards affecting the development of new technologies and content have been agreed upon. Standards have been applied to manufactured parts, for example, originally for the purpose of simplification and interchangeability. Standards have evolved for many other elements of global business, such as language (the national language and specific terminology), the character of the product, the sign (symbol and logo) and the code for the globalised product that the business is developing. Moreover, standards are having an overall economic effect by increasing safety to improve lives and health (Sanders, 1972). ISO has affected the standardisation of environment management and protection (ISO 14000 series) and the IT services field (ISO 20000 series) since 1990.

2.3 Cooperation of the standards organisation

The national, regional and international level standardisation organisations establish compatible standards in the same technology. Standardisation organisations in related

fields are more involved in the standardisation of related technologies at each level with coordination of management between organisations [Schmit and Werle, (1998), p.57]. For example, the IEC has agreed with the WTO, ISO, ITU, WHO, ILO, CEN and CENELEC. Moreover, the mining and manufacturing field is standardising with the ISO and the IEC as the electrics basic rule, under the auspices of the Joint Committee (ISO/IEC JTC1) established in 1987 to standardise these overlapping fields.

2.4 Privatisation of standards

Standardisation began to receive attention as a competitive business strategy in the 1990s. Until then, de jure standardisation which is public standardisation usually occurred after the technology had permeated the market. This is post-standardisation [Etoh, (2008), p.6]. However, the de facto standard came to be acquired by market competitors as exemplified by VHS technology, VCRs, CDs and DAT. Therefore, acquiring the de facto standard became the business strategy of multinational companies (Grindley, 1995; Yamada, 1997). However, market leading enterprises might weaken after their standard technology is acquired by competitors, and therefore, a single company had difficulty in creating a de facto standard. Then, with the WTO/TBT agreement, firms recognised that a formal (de jure) standard was the only feasible international standard.

The de facto standard did not sustain long-term interest, although it influenced the market introduction period [Shibata, (2000), p.43]. The number of decisions to create de facto standards decreased from 1995 through 2000, whereas those of de jure standards increased (Takeda, 2008). The method for proposing a standard to a formal international standardisation organisation began to spread in the forums and the consortia after the stakeholder obtained agreement (Kajiura, 2005, 2007, 2008, 2009, 2010). The standard created through that decision process is distinguished from the de facto standard determined by market rivalry as a 'consensus-based standard' [Etoh, (2008), p.7]. That is, standardisation as a business strategy has changed from the de facto standard to the consensus-based, de jure standard.

2.5 Change in the competitive pattern

The competitive pattern of standardisation has changed as consensus-based standards increase (Kajiura, 2007, 2010). In the past, standardisation competition was caused by de facto standardisation, characterised by market rivalry among firms, which determined the new standard. However, in the current model of the industry forum, consortium and standardisation organisation, firms cooperate in consensus-based standardisation, and the standard is determined by mutual agreement before production and competition on other product features begin. Thus, the previous single-step competitive pattern has become a double-step pattern with standardisation consensus preceding market rivalry.

2.6 Closer relationship between the standard and patents

Another phenomenon has appeared in standardisation along with a priori consensus: the relationship between the standard and patents has become closer. The model has

begun matching the patent of the firm's exploitation technology to the de jure standard. Since 1980, this phenomenon has become a marked trend (Nawa, 1990; Fujino, 1998; Etoh, 2007). Although no such case existed before 1982, that model has grown according to Yamada's (2009) investigation of ITU-T, shown in Table 1. Formulating the patent to the de jure standard enables its industry-wide adoption as easily as the firm implements it in its own technology. This business strategy capitalises on the industry requirement to adopt the patent for the firm to receive patent royalties from a wide range of users. Thus, by the current model, the patenting firm privatises the standard [Nawa, (1990), p.15].

Table 1 Patent application number per year

1983–1997	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)

3 Open innovation perspective

3.1 Open innovation

Open innovation is "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. Firms can and should use external ideas as well as internal ideas" (Chesbrough, 2003, 2006; Chesbrough et al., 2006). Thus, traditional innovation is the closed, vertical and integrated type in which business resources and activity remain within one firm (closed innovation). In contrast, open innovation involves horizontally distributed resources and activities, using external resources to minimise strain on the firm's internal resources. That is, a firm uses open innovation to engage the knowledge and resources of other companies in developing its own technology.

At first, open innovation was a significant change for firms at a high level of the enterprise, and even recent research has focused on open innovation at the internal level of individual firms at the early stages [Chesbrough et al., (2006), p.7]. The present study examines open innovation not only within a firm, but also its initiation at the institutional organisation level and among several firms in the industry.

The patent business strategy is described from the viewpoint of the open innovation paradigm. In open innovation for patents, the patent owning firm makes cross licensing and other patent usage agreements with other companies to obtain earnings. Each firm constructs an effective business model by licensing the patents of other companies, whereas closed innovation monopolises the patent within the originating firm and excludes other companies [Chesbrough, (2003), p.10]. However, Chesbrough does not examine whether the patent strategy at the individual corporate level constitutes a dominant business model for competition between the enterprises within a global institutional organisation or between global institutional organisations (Ollila and Elimquist, 2011; Lichtenthaler, 2011).

3.2 Business model

A business model refers to the competitive dominant business system that increases earnings (Afuah, 2004). The significance of the business model is described from the viewpoint of open innovation (Chesbrough, 2006; Chesbrough and Crowther, 2006; Chesbrough and Appleyard, 2007; 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 closed innovation business model structure is limited and static. However, the probability of success of the business increases because an open innovation 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 (Paik and Park, 2010). Furthermore, in recent years, joint ventures, alliances and both types of cooperation are concomitant (Eriksson, 2011). The relationship between collaborative organisations is called the coupled type, e.g., open innovation in an R&D business and open source development among enterprises and communities, universities and institutions (Enkel et al., 2009).

3.3 Criticism of open innovation

The benefit of open innovation is to create value by using an innovation among the enterprises that cooperated in developing it. If such an utopia is feasible, it would be wonderful. However, criticism of open innovation (Nishino, 2010) warns that it exposes a vertical, integrated business's internal functions to the other companies upon which it depends for open innovation. This may, in turn, narrow its capacity to control the full scope of its business systems, and thereby fail. Nishino describes this problem as follows:

1 Sharing the idea and related technology exposes important information on resources and business flow to other companies.

2 Full information sharing involves considerable difficulty and cost.

3 When other companies perform some of the work, they acquire the resulting knowledge, and the firm loses the potential long-term competitive edge it might have had from that knowledge.

4 The horizontal distribution business model depends excessively on external procurement. Therefore, the enterprise may encounter complications if the system changes with technical improvements, whereas the vertical, integrated business model adjusts easily to such changes.

5 It is difficult to distribute earnings equitably among the stakeholders.

This criticism underscores the difficulty in constructing an open innovation business model wherein the firm maintains a competitive edge. Firms must identify a strategy that ensures their success. Nishino (2010, p.50) suggests that a firm may succeed by restricting dealings to only trusted traders (those who do not deal with unspecified partners). This suggests moving the arena of open innovation from inside a single firm to the higher level of the institutional organisation that owns the participating firms. Moreover, this approach suggests opening innovation only restrictedly and working only within the scope to which the institutional organisation can adjust.

4 Cases

The cases were investigated through 23 interviews of enterprises and the Standard Setting Organisations (September 2005 February 2011). The study examines each case from the content obtained from the interviews on the business models for standards and patents. The corporate cases are those of Denso, Hitachi, Intermec and Mitsubishi Electronics.

4.1 Denso: QR code

Denso (a TOYOTA Group company) introduced a lean production system into the corporate dealings with the production site in 1971, and then introduced a point of sales (POS) system to improve the efficiency of the lean production system. The bar code used with the POS system could input data via a reading device and record information. However, the bar code at that time was one dimensional, which restricted the volume and type of information it could contain. Moreover, the reading accuracy and speed were insufficient. The two-dimensional bar code (QR code: means Quick Response code) solved these problems with ten 100 times the memory and data preservation capacity of the one-dimensional bar code and the ability to recognise Japanese and Chinese characters and images. Moreover, its reading accuracy and speed were excellent. To improve the reading function, Denso developed the CCD (charge coupled devices) semiconductor technology as an excellent storage medium with greater speed and miniaturisation. This technology enabled the development and practical application of Denso's original and precise QR code system.

Since its introduction, the QR code has not only been used within the Toyota group, but has also become an international standard and a commodity that Denso sells externally. Denso proposed the QR code to ISO through the Japan Auto Identification Systems Association (JAISA), and the QR code became the ISO standard in June 2000. Denso acquired the international standard because it was determined that international standardisation was necessary for the global use of technology after the WTO/TBT agreement took effect.

Although the QR technology is assumed to be Denso's patent, Denso has never charged for the QR code's use so that it could enter the public domain via the internet. QR code profits are obtained from sales and service of the QR code system unit containing the reading and writing devices. Because it is dominant in an original technology for the reading device and it enjoys large trade revenues in the automotive and the distributive trade industries, Denso maintains the highest market share in the industry.

4.1.1 JAISA

Japan Automatic Identification Systems Association (JAISA) Corporation was established in 1986 and took the following actions in automatic recognition technologies such as bar codes, biometrics and RFID:

1 conducted a market analysis study

2 planed and proposed standards

3 had spread information about it

4 exchanged it with overseas trade partners.

As of 2010, JAISA has 130 member companies. The auto identification market has a horizontal distribution industry structure: exchanging parts and devices with each other. Denso acts similarly in that it manufactures only the reading and writing device units containing its own bar code system for technology exchange with the JAISA member firms, having introduced the QR Code through JAISA.

4.2 Intermec: RFID

Radio frequency identification (RFID) is a memory medium called an IC tag or an IC chip in a narrow sense. In the broadest sense, RFID refers to information transmitted by electronic signal and electromagnetic radiation from an IC tag and the entire equipment technology for writing and reading the codes. RFID can be used as an information system with a wide range of applications in information society infrastructures such as goods distribution, production management and factory automation (FA) (Lee et al., 2009; Miragliotta et al., 2010). Many applications for RFID technology patent numbers exist with applications for RFID patents increasing rapidly since 1990 and peaking around 2003 (Japan Patent Office, 2005). International standardisation for RFID has been in effect, and standardisation for wireless telecommunications, in general, has been proposed in ISO/IEC JTC1 SC31.

Intermec incorporated is a US-based IT company, established in 1966. Through mergers and acquisitions, Intermec purchased IBM's RFID technology in 1997. Intermec's current business as shown in Table 2 grew from the original business through purchasing technology from the other companies, and now successfully uses the open innovation business model of selling the technology that it purchases to other companies and competes effectively in the market.

Intermec submits its annual report to the US Stock Exchange as a publicly held corporation, revealing its patent strategy (Intermec 2007 Annual Report, 2007). Intermec owns 595 patents and exercises its patent rights. Intermec's basic patent strategy is to have an inclusive license agreement with another firm: "We have obtained approximately 595 patents and a number of trademarks, copyrights and trade secrets. When appropriate, we have obtained licenses to use IP controlled by other organisations. The combination of our IP and our licenses to use third party IP has been of value in the growth of our business and is expected to be of value in the future" [Intermec 2007 Annual Report, (2007), p.11]. In addition, Intermec has received settlement fees of USD 16.5 million from the lawsuit it brought against its competitor Symbol Technology in 2005. Following the lawsuit, the two companies are assumed to have an inclusive cross-license agreement,

and to have completed the transfer of a large sum of money per the judgement (Computer World website, 2008).

Table 2 Intermec Inc. history

Year	*Content*
1966	It establishes itself as an interface mechanism company.
1982	The name of the company is changed to Intermec Inc.
1991	It is purchased by the Litton industry company.
1994	The owner right is transferred to Western Atlas.
1997	The owner right is transferred to UNOVA, Inc.
	The Norand Co. and the United Bar Code Industry company are purchased.
	The RFID semiconductor technology is purchasing acquired from IBM Corporation.
1998	High frequency RFID business is acquired from Amtec Corporation.
2006	UNOVA, Inc. begins to act as related company of the Intermec Inc.

Source: Made from Intermec Inc. homepage, http: //www.intermec.com/

Furthermore, Intermec enforces its inclusive license agreements as well as the cross-license strategy. In an inclusive license agreement, the licensor offers the licensee the use of many patents, specifying the field for their use and contract inclusively. Intermec can conclude an arrangement by individually negotiating with other companies for its patent technology and knowledge required for the practical use of its technology. Intermec has been negotiating 'global RFID licensed programme' agreements comprising the protocol, IC tag and read/write technology with companies since the ISO RFID standard was approved by the ISO/IEC, and obtained large license fees since November 2002 (BemroseBooth site, 2008).

4.3 Hitachi: biometrics

Biometrics is a technology that recognises individual characteristics of living bodies such as fingerprints, irises and retinas to identify an individual, and hence has become a data source for information systems. Individual information is loaded onto a medium such as IC cards, built into IT products such as cellular phones and personal computers and sold. The international standardisation of biometrics is currently managed by ISO/IEC JTC1 SC37. Hitachi participates as a member of SC37 and contributed a technology element to the international standard (ISO/IEC 198794–9), the data of a finger's blood vessel image. In biometrics, Hitachi's finger vein image technology is highly valued. When Hitachi's original finger vein technology was in development, in 1995, the Central Research Institute coincidentally discovered the related optical topography technology. Thus, the discovery of the vessel pattern that replaced the fingerprint and its related technology occurred by chance. Hitachi has by now acquired at least two technological patents for the vein recognition technology used in data acquisition, feature extraction, collation and judgement technology. However, the biometrics market remains too small for Hitachi to follow the Denso business model. Hitachi granted Sagem Security in France the use of patent rights for its finger vein recognition technology and receives the license fee; however, this technological development exchange with Sagem brings Hitachi only small earnings. Hitachi's many patents are primarily used for rights protection.

Hitachi actively participates in ISO/IEC JTC1 standardisation. Its patent was not built specifically to the standard because each company wants to own its specific technology as well as its expertise rather than open it to all firms in the biometrics market, in which case they are pressured to license it cheaply or for free. Thus, theirs is a corporate strategy to avoid losing the market domination they enjoy from having the technological know-how from which the technology flows. The original market structure that depends on each company's closely held technology will collapse eventually, and thus this industry avoids incorporating each company's individual technology into the industry standard. The content of standardisation has to date been limited to one commonly used technology and the minimum communications technology required for the terminal union, interface specifications, data exchange and accurate interchangeability and interconnectivity.

Sales of the finger vein ID system began in 2000, focussing on financial institutions. In addition, the system's design and specifications have been improved, and the miniaturisation is complete. Since 2010, it has been available through three companies (Hitachi, Hitachi Omron Terminal Solutions and Hitachi Information Control Solutions) related to Hitachi, making Hitachi Group the industry sales leader at 4.14 billion yen for fiscal year 2009.

Although Hitachi provided the finger vein recognition technology to the international standard, it does not obtain income from patent licensing. In that respect, its business model is similar to that of Denso's QR code. Although Hitachi's technology is in the standard, the difference is that Hitachi does not include some secret elements in the technology provided to the standard. Thus, in the biometrics industry, the published standard and the originator's technology differ in the managing technology disclosure.

4.4 Mitsubishi Electronics: patent and standardisation

Mitsubishi Electronics is aggressively acquiring technological patents, and now owns over 35,000. After the WTO/TBT agreement took effect, Mitsubishi Electronics began incorporating its patents into the international standard. In 2000, Mitsubishi Electronics created a department to negotiate with the Institute for Policy Research (IPR) and an IPR centre under the president's direct control to work on IPR-related business. Mitsubishi Electronics applies several patent strategies. They may provide their patented technology to the international standard, enter licensing agreements in cooperation with other companies or prevent other companies' use of their patent, an exclusive monopolistic right. Mitsubishi Electronics chooses the appropriate strategy for each patent on a case-by-case basis to achieve 'maximisation of the corporate value to the IPR'. Twelve patents with the international standard are publicly available, two of those examples are considered here.

4.4.1 CLPA

The CC-Link Partner Association (CLPA) is a corporation organisation that Mitsubishi Electronics established in November 2000 with the purpose of permeating the FA field network industry with CC-Link network technology. There are now 1,130 corresponding products and 1,500 member companies with a total of approximately 8 million shipment nodes (connections) as of fiscal year 2010. CC-Link has approximately a 40% market share and leads the Asian region in sales. Members can license the technology offered,

including its technical intelligence, specifications and other elements, along with the right to conformance testing required by the rule for licensing fees. However, non-members do not have those privileges. Because Mitsubishi Electronics initiated the CLPA, CC-Link became the international standard when the CLPA nominated Mitsubishi Electronics' technology to the ISO and IEC. The FA field network industry and the AIDC market are horizontal distribution structures for CC-Link, and the product system is generally constructed through the cooperation of each maker and the vendor.

4.4.2 License management company

The patent pool is the organisation (license management firm) that manages licensors' patents, collecting licensees' license fees and distributing the fees to the licensors. Mitsubishi Electronics' patent pool is shown in Table 3. Mitsubishi Electronics' patent pool technologies are currently MPEG-2 (image compression technique), DVD-6C (DVD ROM and video format technology), Platform WCDMA (3G cellular technology) and the ARIB standard (digital broadcasting access control technology). The MPEG LA management company has been handling MPEG royalty collections (MPEG LA, 2009). Mitsubishi Electronics prevents losses of license fees by using the patent pool to reduce collection costs while managing its sector of the patent business.

Table 3 Mitsubishi Electronics' patent pool

Patent pool name	*Target product*	*Number of essential patents*	*Licensors/licensees*
MPEG-2	DVD device, disk and digital TV	789	22/1,328
DVD-6C	DVD player, recorder and reproduction and record disk	2,944	10/452
Platform WCDMA	3G cellular phone	278	11/-
ARIB standard (digital broadcasting)	Digital TV broadcasting receiver	263	15/96

Source: Made as of July 2008 from public data of each group

5 Modelling

5.1 Dimensions of making models

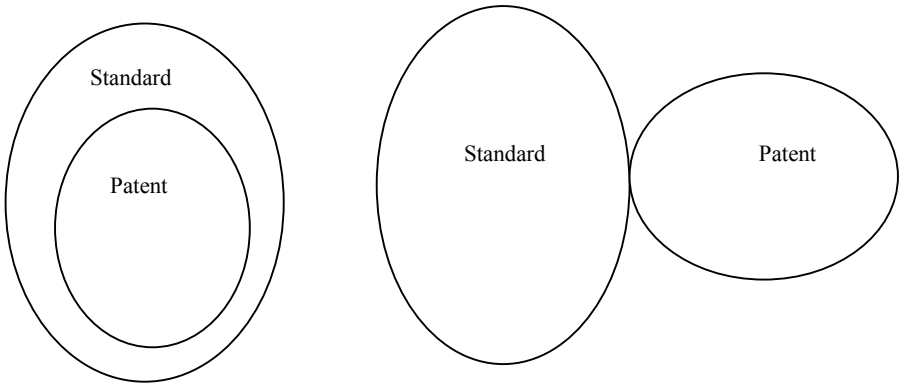
The modelling relates the standard to the patent, and the author establishes the basic dimensions as follows.

5.1.1 Core and periphery

The patent may be incorporated either into the standard when the enterprise relates patented exploitation technology directly to the standard as an essential element of it, or the standards organisation might deem the patented technology compatible but not

essential. The former model places the patent in the standard's core, while the latter does not incorporate the patent into the standard but places it peripherally (Figure 1).

Figure 1 Relational concept chart: standard and patent



5.1.2 Institution and corporation

Although the open innovation might not work at the corporate level, it works well at the institutional organisation level or between firms. The standardisation trend has shifted to the consensus-based (de jure) standard from the de facto standard established by a single corporation's patented technology. The level at which open innovation occurs can be established at the corporation and the institutional organisation level, which in turn affects the choice of an appropriate business model.

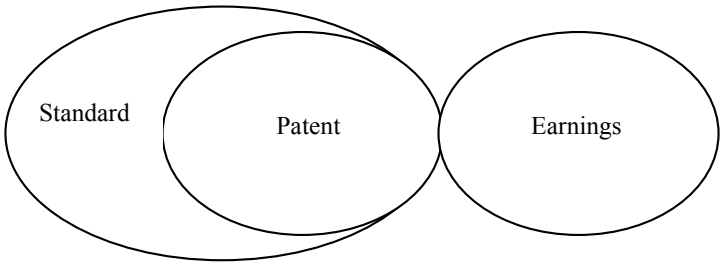
5.2 Business model

The author has identified model's 'type' dimension, where the patent is either incorporated into the standard as a core type model, or the standard and the patent are independent in a periphery type model. Moreover, the author has established the model's 'level' dimension, where the open innovation strategy works at either the corporate level or the institutional organisation level. Thus, the author models the dimensions of the two axes of the business model of each company case.

5.2.1 Denso model

Denso owns the QR Code patent as an international standard. The relationship between the standard and the patent is the core type model (Figure 2). Denso offers the technological patent publicly free, in a strategy to spread it as the standard. Denso used the JAISA organisation to create a product system with other industry members and spread the QR Code technology. Thus, Denso has conducted open innovation. The business earns revenue not by license income from other companies but by sales of total packages including the hardware equipment, software, services and maintenance.

Figure 2 Denso model concept chart



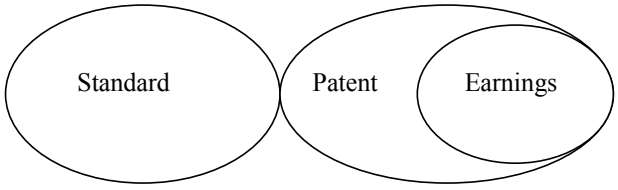
5.2.2 Intermec model

Intermec's RFID business follows the periphery type model of the relationship between the standard and the patent. Intermec does not apply the strategy of having its patent incorporated into the RFID standard and acquiring the standard as shown in Figure 3. However, when a third party tries to manufacture an RFID product in accordance with the standard, the party must use Intermec's patented technology.

Intermec's business strategy is built upon technology it had previously purchased externally, now earning revenue by selling the rights to use its resources to other firms. The manufacturer and the third party vendor must pay Intermec's license fee to use the patented technology. When the firm links its patent to the standard, the patent licensing must usually be free of charge or very low per the ISO/IEC JTC1 patent policy governing firms that participate in the standardisation. Intermec did not participate in the standardisation of RFID to evade this constraint; instead, individually negotiating high-priced license fee contracts with the manufacturers and vendors after the RFID standard was established.

Intermec has succeeded in opening innovation by skilfully using the standard and its independent ownership of the patent through this strategy.

Figure 3 Intermec model concept chart

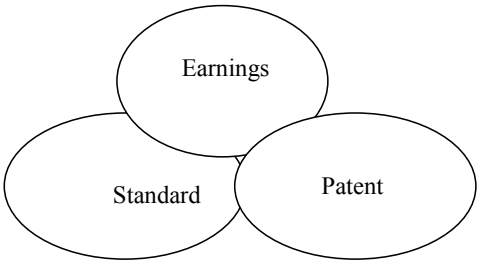


5.2.3 Hitachi model

Hitachi has kept its standard-to-patent relationship a periphery type model, as shown in Figure 4. Its major earnings are not obtained from the standard and the patent but rather from targeted marketing through three companies specialising in different markets, and it has succeeded with that strategy. Hitachi sells equipment and systems built to a standard specification, and the patented specification is combined with software that Hitachi offers to the customer as a total package. Moreover, Hitachi maintains a long-term relationship with the customer through after-sales service and maintenance. Thus, Hitachi has

established the business model of obtaining earnings through combination packages of systems and after-sales contracts. In addition, Hitachi has built a relationship with JAISA and maintains open innovation for standardisation and technology exchange.

Figure 4 Hitachi model concept chart



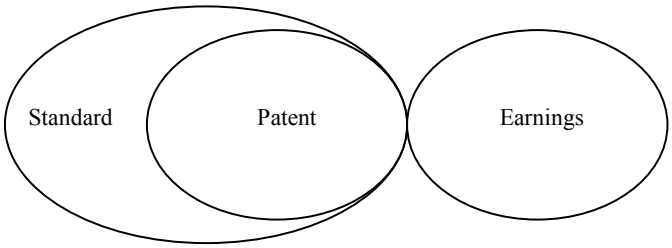
5.2.4 Mitsubishi Electronics model

5.2.4.1 FA field network

To build networks compatible with safety standards' conservative line and with IT devices, many network technologies, called FA field networks, are now installed in production plants. Such networks are hierarchies by the content of the service space and the network information. Field level networks are of high speed and control factory line devices. These networks adhere to the ISO and IEC international standard for networks with a programmable logic controller (PLC) substituting for a relay circuit and to which various field equipment is connected. FA field network products are CC-Link (Mitsubishi Electronics), PROFIBUS (Siemens) and Device Net (Rockwell).

Mitsubishi Electronics standardises their CC-Link field network technology internationally (ISO 15745-5, IEC61158, 61785). The technological patent (Network System for a Programmable Controller: Patent No. 3343036/Japan) for which Mitsubishi Electronics applied in Japan, the USA, South Korea and Germany is incorporated into the IEC international standard. Its usage licensing is free of charge, and the relationship between the standard and the patent is the core model. Their earnings are generated not from the patent but from CC-Link's increasing sales of relevant products and services. Mitsubishi Electronics established the CLPA in November 2000 to spread CC-Link technology, and the CLPA continues to spread CC-Link's technology through technology exchanges. Thus, the CLPA contributes to CC-Link earnings and to Mitsubishi Electronics' open innovation.

Figure 5 CC-Link model concept chart



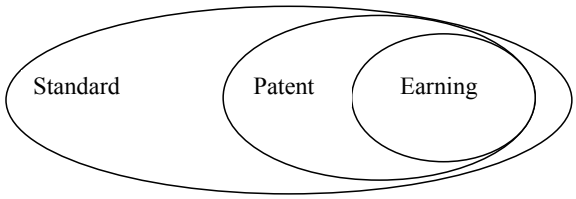
5.2.4.2 Patent pool

License management consignment occurs through a patent pool-licensing firm in industries with many patents and patent numbers. The license management firm acts as a proxy for the licensor (patent provider/holder), and the management mechanism then distributes royalties to the licensor (patent holder). Recently, this method received scholarly attention as a method of patent management (Fujino, 1998, 2006; Katoh, 2006). In general, when the patent is incorporated into the standard, the licensor is obligated to accept a reasonable and non-discriminatory license fee because a great many licensees use the standard, providing the patent owner a high volume of low-fee royalties for a reasonable profit. Moreover, licensors save time on the numerous fee negotiations they would otherwise have to perform. From the industry perspective, patent use becomes possible for everyone, with the patent incorporated into the standard, and the patent-to-standard relationship is the core model.

The MPEG LA management company has been handling MPEG royalty collections. In this patent pool, it is assumed that the income exceeds 10 billion yen from the approximately 800 licensees (Yamada, 2009).

Mitsubishi Electronics' patent pool follows the core model. The purpose of a patent pool is to spread the technology and to avoid discrimination charges under antimonopoly laws (Katoh, 2009). Patent pools do serve to reduce costs and stabilise profits for both parties, and thus, support open innovation by increasing the convenience for both licensors and licensees.

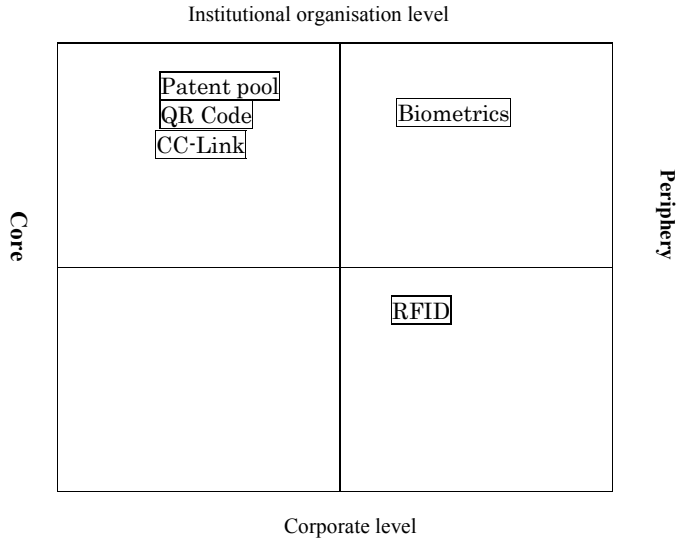
Figure 6 Patent pool model concept chart



6 Business model comparison

Denso, Intermec, Hitachi and Mitsubishi Electronics represent the features of both the core and peripheral business models regarding the relationship among the standard, their patents and their earnings. Figure 7 is a conceptual diagram showing the positioning of each company, and Table 4 summarises their full profiles. Each company has selected an original positioning through an appropriate strategy for their goals in the two-dimensional matrix. Figure 7 illustrates each firm's position in the quadrants defined by the two axes: periphery versus core business model and corporate versus institutional organisation innovation placement.

Figure 7 Matrix concept chart: standard and patent



Source: Made by the author

Table 4 Standard, patent and earnings source of each company

Company name	*Denso*	*Hitachi*	*Intermec*	*Mitsubishi Electronics*	
Standard	QR code	biometrics	RFID	CC-Link	Four technologies of patent pool
Dimension 1	Institutional organisation (JAISA)	Institutional			
Organisation (JAISA)	Between enterprises	Institutional Organisation (CLPA)	Institutional Organisation (license management company)		
Dimension 2	Core	Periphery	Periphery	Core	Core
Earnings source	Product and service	Product and service	Patent royalty	Product and service	Patent royalty

Source: Made by the author

The interesting results shown in Table 4 concerns each company's primary source of earnings. Each company's primary source of earnings is determined by its positioning on the two dimensions. That is, to secure its primary source of earnings, each firm identifies its most advantageous strategic position in the matrix. For example, Intermec uses the periphery type business model as shown in Figure 7, it does not incorporate the patent

into the standard, and it performs license negotiations between the enterprises to obtain earnings. Intermec accumulated business resources by purchasing the original RFID technology from another firm. Thus, Intermec's open innovation is at the corporate level. In the four other cases, the firms spread their technologies through their institutional organisations or the patent management company in which they participate. Thus, they achieved open innovation. The technology spreading institution (e.g., JAISA and CLPA) supports the standard in business model of the patent-owning manufacturer, and it participates in the patent pool management firm, which reduces both the patent owners' and the licensees' costs.

7 Conclusions

Although open innovation is effective for the enterprise, it is difficult to identify the point of failure in an environment of extreme openness.

In the corporate case, this study introduces each company constructed its business model based upon who obtained earnings by relating the patent to the standard. Establishing two dimensions, core versus periphery and corporate level versus institution level, for relating the standard to the patent demonstrated that each company was positioned differently. That is, either the core type or periphery type of business strategy model was selected for relating the patent to the standard. In order for the business model to succeed, it is also important that the enterprise optimise the relationship with the other companies at the appropriate level and achieve open innovation through an appropriate mechanism.

One criticism of open innovation is that its exposure of a firm's information risks eventual failure. To avoid such failure, a firm should mitigate its risk by restricting its dealings to only trusted trading partners (those who do not deal with unspecified partners).

Overall, it was confirmed that institutional organisation level open innovation was effective in the business model relating the patent to the standard, part of the standardisation trend shifting from the single-corporate level (de facto standardisation) to the institutional organisation level (consensus-based standardisation). Case studies of achieving open innovation at the corporate level focused on Intermec and Qualcomm [Chesbrough, (2006), pp.206–209]. The Qualcomm analysis suggests that it is difficult to maintain a competitive business model at the corporate level because of the high labour cost. Thus, the open innovation model's success might reflect the shift to the institutional organisation level from the corporate level because the enterprise can obtain a better return on its investment at the higher level of the institutional organisation or between the enterprises.

This paper set out to explore business models of open innovation and has identified four types .The main theoretical contribution is to the relation of collaborative innovation at the institutional organisation level.

This paper builds on the results from four cases, which means that the scope for generalisations is limited. More research is needed. Also research of open innovation is usually from the single-corporate level. Open innovation within a specific field such as the institutional organisation should be examined to extend open innovation research.

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