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Mechanism of Changing a Product Concept

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***Abstract*—**The purpose of this paper is to examine the hypothesis explaining the mechanism in the case, where the product is deleted or reduced the fundamental function of the product through the product concept changes in the digital camera industry. This paper points out not owning the fundamental technology might cause the change of the product concept. Casio could create new competitive factor so that this paper discusses a possibility of the mechanism of changing the product concept.

***Keywords*—**Casio, digital camera, mechanism, product concept, product development process.

I. Research Question

THE purpose of this paper is to examine the hypothesis explaining the mechanism in the case, where the product is deleted or reduced the fundamental function of the product through the product concept changes in the digital camera industry. When a dominant design is formed at the introductory period of industry, it is said that the generating frequency of the product innovation decreases and the generating frequency of a process innovation increases [1]. Therefore, it is assumed after dominant design formation that a company competes at a single dimension. However, without the competition performed among companies remaining only in a single dimension, firms looks for the source of a new competitive advantage. This paper shows the mechanism which changes from a single competition dimension.

When competition at a single dimension is developed, some researchers show that it becomes price competition [2]. It is common in such a competition situation to reduce cost by reducing product functions or suppressing a performance level. However, although the phenomenon of deleting and reducing the fundamental function of a product is seen in the case of this paper, it is not for cost reduction. It is for pursuing a different competition dimension. Although there are researches which deal with two or more dimensions until now, there are few papers in which the process until it converts into other dimensions was shown in detail. Especially, it is difficult to devise competition at a new dimension by reducing the prime function of a product. This paper tries to clarify the process through case analysis.

This paper takes up Casio Computer which developed the digital camera "EX-S1" put on the market in 2002 as the case study. A digital camera is equipment which records the photoed still picture as digital information, and consists of an image sensor equivalent to the "eye" of a camera, and an optical lens which makes a photographic subject image optically to it. These are playing the fundamental function of the digital camera. It is said that "QV-10" which Casio put on the market in 1995 is a dominant design of a digital camera, and a digital camera came to be considered as an alternate product of a film camera after that.

Since "QV-10" had 25mega pixels CCD and a single focus lens, the photoed image quality was not able to be said to be enough when comparing with the image quality of the film camera. Therefore, each entry company thought that improvement in this photograph function led to strengthening of competitive power, raised the pixel of the image sensor, and has performed technical development which improves the magnification of optical zoom.

For example, the pixel of the image sensor mounted in the digital camera was about 35 mega pixels in 1995, and over 100 mega pixels appeared in 1997. After that, the digital camera have had 2 mega pixels in 1999, 3 mega pixels and 4 mega 5 mega pixels in 2000, and 6 mega pixels in 2002. Thus, the digital camera mounting one image sensor after another with a high pixel count is put on the market. Also after that, this tendency is keeping on and this is one of the factors which maintain the competitive power of Japanese companies highly. Moreover, the large magnification of the lens also progressed. Although there was a product mounting a single focus lens at the beginning, the product which mounting optical zoom immediately was put on the market.

However, raising such product performance is not only necessarily connected with competitive advantage. The speed of the improvement in product performance is quicker than the improvement speed of the capability for a customer to be able to use the function [3]. Therefore, when product performance exceeds a customer's demand standard, the customer's product evaluation is diversified. It is a product price which especially a customer thinks as important, and low-pricing of products comes to progress. The average unit price of the digital camera was 44,800 yen in 1999 was falling to 32,500 yen in 2002.

The fall of this average product unit price is caused by the cost fall of a device. The scale of the digital camera market has been expanding quickly since 1995, therefore the experience curve effect works to device production, and the cost per one unit of devices had fallen. Moreover, the price had fallen with devising product deployment. The case of a digital camera uses the almost same case among several models. And Casio developed the product which attached the difference to the pixel count of an image sensor, or the magnification of optical zoom. The image sensor of 2 mega pixel CCD, 3 mega pixel CCD, and 4 mega pixel CCD was mounted in the same exterior and Casio could have arranged from the low price goods using a cheap device to the high price goods with the newest device. Thus, the price of product fell by giving a clear-cut solution to a part of photograph function.

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However, it was not only the firm which gives a clear-cut solution to a product function for low-pricing of products. There is the firm which gives a clear-cut solution to a product function also for the other reason. This paper takes Casio and analyses the product development process of "EX-S1". "EX-S1" compared with the model of competitor of the Casio, the pixel count of the image sensor was stopped low and optical zoom and autofocus (AF) were excluded and it was made low in the photograph function. On the other hand, EX-S1 was not necessarily a cheap price product for 35,000 yen, while the average unit price of the digital camera in 2002 was 32,500 yen.

After forming commercial digital camera industry in 1995, every entry company has improved the photograph function. This paper examines why Casio developed the digital camera "EX-S1" which gave a clear-cut solution to the photograph function.

For the purposes of this paper, a fundamental technology is defined as a resource for designing and producing core devices. The elemental technology constituting a product is roughly divided into the fundamental technology and peripheral technology [1] categories. The fundamental technology [2] is a technology that satisfies two requirements. One requirement is a technology for working the "basic function" provided by a product. Secondary, when each firm enters the market, its fundamental technology is recognized as the technology composing the primary part of the product, and fundamental technology decided by the overall industry. The recognition subject is the set of manufacturers, and the timing for recognizing the fundamental technology is an introduction stage in the industry. It is the technology that is developed continually and improves the function level. In contrast, the peripheral technology is defined as the technology concerning all devices except the fundamental device.

The digital camera has stemmed from the image sensor invented in Bell Laboratories in 1970. The image sensor was called "the electronic eye." From that time, the concept (electronic still picture photography recording equipment) of a digital camera has been considered. A digital camera is equipment which records the photoed still picture as digital information, and it consists of an image sensor which changes light into an electrical signal, and an optical lens which makes a photographic subject image optically to it. Therefore, it can be said that an image sensor and an optical lens bear the fundamental function of a digital camera. Moreover, high-definition competitions, such as higher pixels of an image sensor and higher magnification of optical zoom, have been developed after "QV-10" in 1995. Therefore, set makers have recognized the high performance of an image sensor and an optical lens as a central technical development subject. As mentioned above, in this paper, the image sensor device, such as CCD and CMOS, and optical lens device are set up as fundamental technology.

In addition, secondary data, such as interviews to Casio, other digital camera makers and a CCD maker, a homepage of each company, a newspaper, a magazine and various statistical materials, are used for the case study.

II. Case Study

A. The Outline of Digital Camera Industry

The use of the digital camera was business use before 1995 and it had more than 100mega pixels CCD and was highly efficient. However, it was 1 million yen or more. On the other hand, "QV-10" had 25 mega pixel CCD, the single focus lens, the 1.8-inch liquid crystal color display on its back and low price about 65,000 yen. It attached greater importance than to image quality to handiness with cheap prices. That is, the concept of "QV-10" was "wearable camera."

The film camera which uses a photographic film as a storage media was main purpose of use till then. However, customer needs shifted to the digital camera from the film camera after the digital camera appearance. In 1997 and afterwards, instead of the shipment number of film camera and the amount of money for shipments of them and decrease, and the shipment number of digital cameras and the amount of money for shipment of them increased (Fig. 1). The shipment number of digital cameras reversed it of the film camera in 2001, and the digital camera became the mainstream in the still camera market.

Fig. 2 shows transition of the market share of each entry company in the digital camera market. Casio recorded 46.7% of the market share by "QV-10" in 1996. Whereas, the company which has developed film cameras, such as Fuji Film, Olympus and Canon, and the company which has developed a video camera called Sony put one product after another on the market, and took the market immediately. Therefore, the market share of Casio decreased year after year.

Competition in the terms of the image sensor and the optical zoom is one of causes that the market share of Casio fell. Many film camera makers and video camera makers recognized the possibilities of the digital camera market by success of QV-10", and have entered into the digital camera market. In order that those companies may attain differentiation with "QV-10", it is by the formation of many pixels of an image sensor, and large magnification of optical zoom. The first megapixel machine "DS-300" was put on the market from Fuji Film in 1997, and "DMC-FZ1" which had 12 times optical zoom is put on the market in 2002 from the Matsushita Electric.

[1] This definition of fundamental technology cannot necessarily be applied to all industries. There are industries in which the fundamental technology does not apply. The apparel industry is one such example, and reexamining this issue is necessary. However, this definition is effective in the industry examined in this paper.

[2] There is a difference between the fundamental technology and the core technology. The core technology that [12] and [13] examined is a technology that is unique to the firm and has multiple uses with several products. Therefore, recognizing the fundamental technology is different from differentiating the respective core technologies in each firm. The fundamental technology in this paper is decided in accordance with product features and a specific technology in one product, regardless of the firm's intention. Therefore, the fundamental technology is a unique technology that is decided by the overall industry. The performance level of the product's basic function does not often meet customer demand standards during the development or the introductory periods of the industry, and the biggest development task is for market expansion [3]. The product then becomes an improvement of the function level of the fundamental technology. Therefore, if the definition of the core technology is used, it is highly likely that all firms entering the market have some technologies and discussing firms without technologies is difficult.

These entry companies have produced the video camera carrying the image sensor technology and the film camera carrying the advanced optical system technology. As typical firms, there are Sony, Matsushita Electric and Canon, Olympus, Fuji Film. These firms have performed accumulation of image sensor technology or optical system technology from digital camera industrial entry or before. On the other hand, Casio has developed electronics products, such as a calculator, a clock and an electronic instrument and it has not had the technological development.

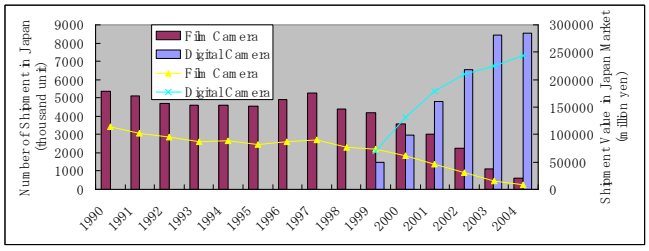

Fig. 1 Domestic shipment and the amount of film-based camera and digital camera in Japan

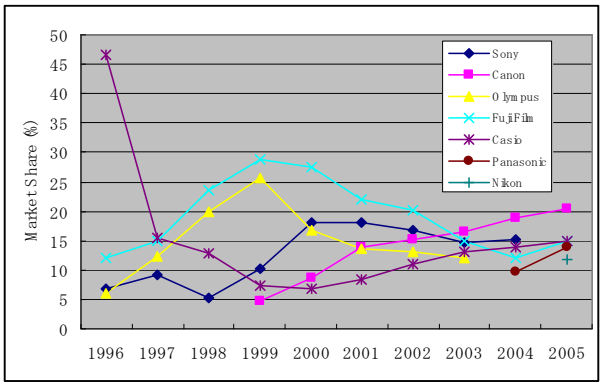

Fig. 2 Market share of digital camera industry

B. The Feature of "EX-S1"

Casio put Exilim "EX-S1 (Fig. 3)" on the market in May, 2002. This model stood on the first place in the volume of sales sale next month, and made a smashing success -- a production system is reinforced in sale three months. And so, the market share of Casio which had hung low to about 5% after "QV-10" was going up to more than 10% by sale of Exilim.

"EX-S1" which was sold at more than 30,000 carried 1.34 mega pixel CCD and the single focus lens which excluded optical zoom, and AF, and a 1.6-inch LCD display. The body was 11.3 mm in thickness, and 85g in weight. After it switches on a power supply, photography becomes possible in about 1 second. The release time lag has taken a photograph in 0.01 second and the seriography was made at intervals of 0.6 second.

The main competition dimension in digital camera industry was the formation of the image sensor and large magnification-ization of a zoom lens in 2002. Entry firms put the megapixel machine on the market in 1998. Furthermore, digital cameras with 3 mega-pixel CCD and 3 times optical zoom were put on the market in 2000.

Thus, as a reason which the formation of many pixels of an image sensor and large magnification-ization of optical zoom followed, it is possible that the product concept of a digital camera of those days is recognized by each company as an alternate product of a film camera. Generally speaking, the pixel of an image sensor needed about 3 mega pixels for the L version print, and loading of optical zoom was standard in the film camera. Therefore, in order to catch up with the photograph function level of a film camera, each entry firm tried to perform formation of many pixels of an image sensor, and large magnification-ization of optical zoom, and enable photography of the high definition photograph.

As mentioned above, while the standard digital camera in 2002 and "EX-S1" were compared, it can easily realize that the features differ greatly. The conventional digital camera had the price range from 20,000 to 50,000 yen, and strong photograph function, such as carrying about 3 mega pixel CCD and 3 times optical zoom. On the other hands, "EX-S1" was sold by more than 30,000 yen, and pursued thin and light body, and quick operation. That is, while "EX-S1" which was the same price range as the existing digital camera strengthens portability and quick reaction, its photograph function was reduced, such as 1.34 mega pixel CCD and a single focus lens.

Fig. 3 EX-S1

C. The Development Process of "EX-S1"

The reason why "EX-S1" was developed is a bad condition of the former "QV" series. After putting "QV-10" on the market in 1995, in order to substitute still camera industry for a film camera, the formation of many pixels of an image sensor and large magnification-ization of optical zoom break out. Fuji Film and Olympus were leading this competition.

Casio also followed this current and it has put on the market the first megapixel machine "QV-5000SX" and the first optical zoom loading machine "QV-7000SX" in 1998, and "QV-4000" which carries 4 million-pixel CCD and 3 times optical zoom in 2001. However, Casio has few sale models as compared with the other company and been behind the improvement in CCD pixel. As a result, the market share in the digital camera market of Casio fell even to 6.9% in 2000.

Even if Casio held neither image sensor technology nor optical system technology but was competing by a CCD pixel or optical zoom, it thought that the special feature of its company could not be set forth. The personnel of "QV section" which has played a role of digital camera development in Casio had been reduced. Therefore, a sense of crisis, whether its Project continues, had been increasing.

"Internet Development Center" was founded in April, 2000. Mr. Tadashi Takasu who has worked in the digital camera division for years was inaugurated as the director of it and about 30 persons transferred to it from the "QV section." "Internet Development Center" aimed at reviving a new enterprise by Internet related. However, since Mr. Jin Nakayama who was bearing the core of digital camera development of Casio until now took the post of the network development department manager and Mr. Susumu Takashima took the post of the development department manager, it comes to aim at digital camera development again. Mr. Takasu thought it wasteful to withdraw from a digital camera as it is and Internet Development Center became *Yami-ken* (the hidden project) of the digital camera. As many members who were in "Internet Development Center" have engaged in digital camera development since "QV-10" development, they went back to "QV-10" which ws the starting point of the digital camera of Casio [4]. "QV-10" could always take a photo whenever and wherever to photograph and could be made a different camera from a film camera. And "EX-S1" will aim at the usage unique to a digital camera.

When beginning development of "EX-S1", Casio held neither image sensor technology nor optical system technology, but if it was competing with the other company with the same dimension of them, Casio thought that the special feature of Casio could not be set forth. Instead, Casio considered that user-friendliness as a digital camera would be pulled out and would provide a customer with new fun. Moreover, among the development departments where Mr. Takashima serves as the manager, there were many engineers of a digital camera division and he pointed to the component-engineering development for slimming down to them [4].

The members of device maker proposed that Casio would develop the card size digital camera which goes into a business card case in a seat of the year-end party with the end of 2000. Casio promised to develop the digital camera of card size. In this way, the directivity of slimming down became clear.

In goods council of Casio in April 2001, President Kazuo Kashio permitted development of a thin digital camera and a development project which was started to work and makes an experimental model and the design of the production model. In order to carry out a thin miniaturization, various components were developed. In this process, the high density mounting technology, LSI design technology, and liquid crystal display technology which have been accumulated through the product development, such as a calculator, a digital watch and an electronic dictionary, and an electronic instrument, were utilized.

First, Casio started the design at the lens module which spends for time to development late in 2000. In order for a case to make thin and weight, the miniaturization of a lens module is indispensable, and it was important for Casio to make the lens of "EX-S1" thinly lighter than high-definition photography performance in lens development. Therefore, optical zoom, AF, and a macro photograph function were omitted. Especially the bottleneck of a thin weight of its case was AF which needs a motor, and a gear and a mass battery. So, in "EX-S1", AF was not carried but pan-focus is adopted. Moreover, the incidence angle of light became large by bringing a convex lens to the head of lens composition and the lens of the invert Tessa system which can slim down a lens unit was carried. And it became possible by carrying a single focus lens, in order to make a main part thin lightly to shorten start-up time and a release time lag physically.

In addition, CCD combined with a lens was miniaturized. However, as evil of a miniaturization of CCD, the area of a euphotic part becomes small and it brings about degradation of sensitivity or a dynamic range. Then, by the close exchange with a CCD maker, CCD was equipped with the on-chip micro lens in order to lead light to a photo-diode efficiently.

When taking such measures, if it is the CCD size of the smallness which can be carried in "EX-S1" in 3 mega pixel CCD, the evil of a high noise and a low dynamic range would become large. Therefore, 3~4 mega pixels was in use those days, and while 3 mega pixels or more are needed for sufficient image quality on the L version print, Casio made a decision 1.3 mega pixels CCD equipped on "EX-S1" in order to drop a pixel count greatly and to enlarge the acceptance surface product per pixel.

Furthermore, Casio cooperated with a CCD maker and developed the technology of HCLi in order to slim down. Before, the CCD chip and the lens were separately supplied from the device maker and were combined by the set maker side and, as for the thickness, about 17~18 mm was common. In "EX-S1" development, Casio could make it the module (HCLi) which unified CCD and a lens, and was able to do it thinly to 8.8 mm with a device maker's cooperation.

Since a case was miniaturized, LSI design technology was used and one module board was made to accumulate CPU, ASIC and SDRAM which were four main LSI, and a flash memory with a silicon chip. This was called MCM which was designed in Casio and Hitachi manufactured and verified. By summarizing four LSI to one, compared with the existing parts, 70 percent of surface area was reduced and lowered power and lowered noise. In addition, a shutter interval can be shortened about 1 second by forming 1 chip. Moreover, software was also improved and the quick operativity of photography, such as interval shooting in about 0.6 second and release time lag in 0.01 second, was made possible.

Furthermore, digital interface TFT liquid crystal was carried for the first time with the digital camera. Casio has been manufacturing the small liquid crystal for a wrist watch, a calculator, and electronic notebooks in the company since 1973, and has been accumulating its technology. An analog peripheral circuitry becomes unnecessary because a digital signal can be directly inputted for a digital image from LSI unlike the conventional liquid crystal display monitor which changed and inputted into the NTSC signal. According to [5], since external parts, such as liquid crystal interface IC and a crystal oscillator, were deleted, as compared with the existing liquid crystal circuit board, its surface area was able to be decreased by 13%.

Since development began in the organization whose people engaged in digital camera development before, the

component-engineering development for slimming down, the product development which started for the new form of the digital camera obtained an idea called a card size digital camera. And component engineerings, such as HCLi, MCM, and a digital interface liquid crystal, were developed, and the thin miniaturization was pursued. Moreover, quickness was made to improve through shortening of operation time mechanically and improving its software. On the other hand, the photograph function was reduced decisively, and the concept "the wearable camera" was formed gradually.

In this way, "EX-S1" carried 1.3 mega pixel CCD and a single focus lens, was excellent in portability by 11.3 mm in thickness, and 85g in weight and became a digital camera with quick operativity.

III. Discussion

A. Product Functions of "EX-S1" and Change of the Priority between Functions

Each digital camera firm has sent out many digital cameras to the market since the digital camera market formation in 1995. Those firms carried out product development which aimed at the image sensor of more pixel counts, and loading of high optical zoom. As of 2002, the lineup of the product was carried out from 2 mega to 5 mega pixel image sensor in combination with from to 5 times optical zoom by AF loading. Moreover, when five firms which had put many products on the market in the first half of 2002 developed the digital camera of which average size was 236.9 mm and average weight was 275.7g.

On the other hand, Casio "EX-S1" carried just 1.3 mega pixel CCD and a single focus lens and excluded AF. Its size was 11.3 mm in long, 55 mm in wide and 88 mm in depth, and its weight was 85g. Moreover, "EX-S1" could take a photo in 1 second after switching on the power supply and take photos continuously in 0.6 seconds, and its release time lag was 0.01 second, and it was sold for about 35,000 yen.

If the existing digital camera is compared with "EX-S1", it can be easily understood that its product function had a big change. "EX-S1" was reducing greatly a photograph function called the pixel of CCD and optical zoom. On the other hand, portability was strengthened by making a case thin small and making it light. In addition, quickness, such as shortening the interval of start-up time, a release time lag, and a seriography, was strengthened.

Change of this product function is regarded as change of the priority between functions. The development race of a digital camera has turned to improvement in a photograph function since 1995. Therefore, many digital cameras were developed aiming at loading of the image sensor of many pixels, and the optical zoom of large magnification. However, portability of a miniaturization and weight saving of a case at "EX-S1" and quickness such as start-up time and a release time lag was pursued. That is, in development of "EX-S1", the priority between functions was changing from the photograph function to portability and quickness. Why did change of the priority between such functions take place? It is thought that it was behind the background of the change of the priority between functions that there was change of a concept.

B. The Concept of "EX-S1"

Since the digital camera market rose completely in 1995, the concept which many digital cameras were sharing has called it "the alternate product of a film camera." That is, it has an image sensor of a high pixel count, and the optical zoom of large magnification, and it can take as high-definition photo as a film-based camera. In order to take a photograph equivalent to the L version print of a film camera, it is said that an about 3 mega pixel image sensor is required, and the product which each digital camera company puts on the market aims at the formation of many pixels of an image sensor, and large magnification of optical zoom.

"EX-S1" had the composition of reducing photograph function called 1.3 mega pixel CCD and a single focus lens, and the portability and quickness were improved. The reason "EX-S1" had such a feature was it had the concept "the wearable camera."

C. The Process of Concept Change of "EX-S1"

Even by the falling the pixel of an image sensor and the removing optical zoom, why did Casio strengthen portability? The mechanism by which "EX-S1" was developed is solved paying attention to Casio not having held the fundamental technology of digital cameras, such as image sensor technology or optical system technology.

Casio is the firm which does not hold image sensor technology or optical system technology, either. Therefore, an image sensor and optical lens must procure from device makers. In the case of digital camera industry, the device maker of CCD or optical lens is also the set maker who makes a product at its firm, and may sell its devices to two or more firms. Therefore, as long as a device is supplied for device from the other firm, it is difficult to be differentiated.

Therefore, there is the necessity of compensating shortage of a differentiation factor with something. It is an idea. The firm without owning the fundamental technology is going to bury lack of a differentiation factor by an idea. This idea could serve as an opportunity which creates a new competition factor.

Experience and accumulation of the product development provides the fountainhead of an idea. Casio has been good at making a product small and light, and has developed a calculator "Casio Mini", "the Casio Mini Card (LC-78)", "SL-800", a wrist watch "Pella (FS-10)", and a portable television "TV-10." Through development of these products, the cognitive framework of the product differentiation, which it can certainly win when Casio makes its product small and light was formed. It progressed to slimming down by referring to such a schema [6], [7]. Moreover, it can enjoy the advantage of quickness, such as decreasing the mechanical operation and processing, increasing the flexibility of component arrangement, speeding up working speed, or speeding up the image processing.

Casio was successful by "QV-10" and recurred in the starting point as "QV-10", and reconsidered new concept. "QV-10"

pursued the new usage unique to a different digital camera from a film camera, and it had the concept "the camera which can take a photo and can check a picture immediately." Therefore, in development of "EX-S1", the portability and quickness which are made just because it is digital would be solicited.

Casio does not own the fundamental technologies. Therefore, since it inevitably procured the fundamental devices from the outside supplies, contact with an device makers would increase. Casio was procuring the image sensor and optical lens from the device maker. Meanwhile, the device maker could catch a product from new viewpoint just because it was outside. Contact with the exterior with such fresh eye serves as an opportunity to obtain a different idea from existing. Before the project of new digital camera development started Casio had got an idea about the digital camera of card case size in the year-end party with a CCD supply maker.

Fusion between starting point revolutions and the idea from the outside formed an outline of new product. In development of "EX-S1", an idea called the unique usage as digital, slimming down and card size had been fusing in the development process.

In order to realize this idea, the firm utilizes the technical resources. Casio has accumulated various technologies through its product development, such as a calculator, a wrist watch and radio, and portable television, and those technologies were used for component development of "EX-S1."

Since the calculator and the wrist watch had the necessity of making lightly and thinly, high density mounting technology has accumulated. Moreover, the LSI design technology which had used on the development of "the *Mieru* radio[3]" was used for development of MCM in "EX-S1." Accumulation of liquid crystal technology began from the 1970s through development of a digital watch and a calculator, and it has been evolved the liquid crystal display. Especially Casio had a strong prejudice in the liquid crystal and was going to differentiate its digital camera by using a new liquid crystal display. In "EX-S1", the digital interface LCD display was mounted in the digital camera for the first time in the world, and it was comparatively large 1.6-inch liquid crystal LCD display considering small body size.

Furthermore, although it is necessary to procure a component from device makers for product development, their technology can be used. Casio developed the CCD lens module of "EX-S1" in collaboration with the CCD device maker. On-chip micro lens technology is used in order to make the CCD lens module thin. This was the technology which the CCD device maker developed for a small 8-mm video camera. Moreover, the CCD lens module HCLi of "EX-S1" was light thinly by designing CCD and a lens as one module. HCLi was the technology produced in the deep relationship between the CCD device maker and Casio.

The product concept was gradually formed as product direction became clear and this component-engineering development progressed. The concept of "QV-10" "the camera which can take photos whenever and wherever people want to do and can show photos immediately " emphasized the immediacy, and led the portability that it could carry at any time and could take out immediately and the quickness that operation was fast and could take a photograph immediately. Casio had the idea giving priority to thin body, quick operation and 1.3 mega pixel CCD, and abandoning the optical zoom lens and AF. Casio developed Components, such as HCLi, MCM, and a digital interface LCD display by using the technical resources and in joint development with device makers. The concept of the "EX-S1" "the wearable camera" which pushed forward the performance of portability and quickness had been forming.

Exploring a new idea, acquisition of FreshEye obtained from contact with the device maker, exploiting the technical resources and exploiting external resources had been supported by psychological energy [6] which the firm without the fundamental technology had. Exploring new idea and mobilization of the resources for realizing it do not take place automatically. There are several strategies which firm can take. For example, the firm could continue the competition on the existing product concept, and could also offer products with cheap prices whereas, Casio progressed to formation of a new concept in the example of "EX-S1." The powerful psychological energy which each staff at "Internet Development Center" had made this possible.

As Casio has not owned fundamental technology, it could not but depend for those devices on outsourcing. Since the same device as the other device would be used on the existing concept, Casio cannot differentiate the product by the factor. Therefore, sales and a market share fell. Casio reorganized and the staffs of the "QV section" which was bearing digital camera development were reduced. Therefore, a strong sense of crisis was held among organization members. "Internet Development Center" that people who share this sense of crisis was established and it burned its boats and could utilized resources towards realization of a new concept. As a result, "EX-S1" which has the concept "the wearable camera" was developed.

IV. Implication and Future Research

It has so far been thought that the motive to reduce a product function is mainly for cutting the cost of the product. In order to develop the product of budget prices relatively, a product variation is expandable by deleting some functions or reducing main functions. However, in the development of Casio "EX-S1", the pixel count of the image sensor was not reduced for the purpose of the cost cut, and optical zoom was not deleted. The purpose which reduced the photograph function which bore the fundamental function of a product was for the prejudice of carrying easily by choosing card size.

It was change of the product concept at the background. The product concept of the digital camera around 2002 was called "alternate product of a film camera", improved the pixel count of an image sensor, mounted the optical zoom of large magnification, and raised the photograph function. On the other hand, the concept of "EX-S1" was "a wearable camera ". Since Casio has not owned image sensor technology and optical system technology, it could not improve the photograph

[3] Radio which can display the information on radio.

function by itself and it was difficult for it to have the product differentiation. Therefore, it searched for other competition factors, portability and quickness was strengthened, and, on the other hand, the photograph function was reduced. That is, since Casio has not owned the fundamental technology, it drove by the necessity for creating the different competition factor from existing. And a new value dimension was produced and it was backed up for the strong organizational sense of crisis borne by the predicament. Then the product with high originality was able to be developed emergent.

In the existing innovation research, for example, a new market destruction innovation [8] and a value innovation [9], it was argued that redefining the product's value which was dominant until now, and shifting to a new value dimension like a business concept innovation [10] created new market. It was the firm which spun out from the established company and a new comer from other industries that become a bearer of an innovation. In the argument on Christensen, the bearers of the destructive innovation were the new companies which spun out from the established company. The bearer of this innovation was explicitly included in the process of innovation, however, in the other researches, it seems that their attentions were seldom paid to the bearer of innovation.

This research focused on the characteristic of the bearer of the innovation. The fundamental technology is defined as the technology which plays the basic function of the product and which the entry company and customer of industry recognize to be important in common. And then, the company which does not hold the technical resources was made the subject of analysis and it argued about how the company changes a concept. That is, the existing competition factor is a company which has a weak point lacking in something as the characteristic of the company which can develop a different factor, and it had become lack of the resources and a drive of creating concept with a new competitive power.

Moreover, the previous researches have discussed what of the concept changed. For example, Pine and Gilmore [11] pointed out the importance of experience which has the impression which a product and service give to a customer. Kusunoki and Akutsu [2] showed that it could be freed from commodity by competition at the dimension which is not invisible of a competition dimension. And it has been shown the tool for new market creation. Kim and Mauborgne [9] probed the strategy profile of the present condition of its company or a competition company using strategy canvas at first, a new value proposal is made by four operations of 4 actions (ERRC).

However, these are neither static analysis nor a tool, and are not necessarily shown as a dynamic mechanism. This paper showed the mechanism in which change of a concept - the necessity of exploring for a new differentiation factor just because this paper focuses on the firm which has not owned fundamental technology and it obtained the idea out of contact with the exterior, used the resources to hold, utilized external resources, formed a new concept, psychological energy backs up realization of a concept.

Finally, it shows the limitation of this paper and a future researches. In this paper, the firm which has not owned fundamental technology would have the process which created a new competition factor from the discovery fact by case analysis of Casio "EX-S1". Although Casio has not owned the fundamental technology such as image sensor technology or optical system technology, this paper points out Casio hold peripheral technology, such as high density mounting technology and liquid crystal technology. Although Casio has not owned the fundamental technology, the firm may hold other technology and may not be so. Future research will change the extent of possession of technology other than fundamental technology, and will analyze other examples. It will build the comprehensive framework about the firm without the fundamental technology. Moreover, although this paper researched the case study of Casio, comparison with firms with the fundamental technology, such as Canon, Nikon and Sony, has not done yet. A part of logic of the firm without the fundamental technology also has that holding fundamental technology turns over. It will pursue the strength of the firm without the fundamental technology comparing with the firm with the fundamental technology.

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