

Knowledge Management and Environmental Strategy: The Connection

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Abstract

Environmental Strategy is gaining importance because many firms have realized that connecting environmental protection with management measures offers significant opportunities in terms of corporate strategy. Examined here is a portion of the results of in-depth case analysis of three prominent Japanese technology firms. Focus is on knowledge management within the firm as a basis for success in the process of new environmental strategy formation. Because factors likely to influence environmental strategy vary according to the stages of development, a corresponding analytical framework is presented for each stage.

Numerous descriptions, explanations and theories of Japanese management are available, but the ones introduced in Nonaka and Takeuchi (1995) best serve for explaining the progress of environmental management as discussed here because they most appropriately highlight Japanese companies' skills/knowledge, and serve to enhance understanding of the externalization of tacit knowledge within the organizations. The corresponding concept of knowledge management, as conceptualized in Nonaka's SECI model, provided the basis for structuring and analysing the in-depth case analyses of the environmental management of the three Japanese firms discussed here.

Results presented here clearly show that, in addition to various external factors that can influence environmental management (Takagaki, 2010ab), internal factors such as knowledge and organizational structures are also highly influential. The results further indicate that domestic environmental strategy will likely permeate throughout Japan's Industry. Significantly, although the management of some pro-active environmental-strategic firms have already embarked on long-term environmental strategy, there are other firms that have been unable to initiate long-term environmental strategy because of their lack of top-leadership and/or inadequacy of knowledge management. Although the results presented here are strongly suggestive, they are derived principally from only three case studies; therefore, further detailed analysis is presently under preparation to supplement this exploratory study.

Keywords: *Knowledge management, Eco-management, Leadership, Case studies, Recycling*

INTRODUCTION

With environmental issues drawing high public interest in the 1990s, some pioneer companies were

already considering environmental measures as a business issue and were actively engaged in significant corporate response, ahead of most other companies. Subsequently, other companies with the

capacity to engage in appropriate responses were influenced by those pioneer companies, and they also started introducing environmental measures into their strategy. What conditions brought about the initiation of such changes? Simply put, there appear to be two major factors: the external and internal environments of the firm.

The key issues include not only the interface between strategy and the external environment, but also the interface between strategy and the firm's internal environment. Because corporate strategy concerns the matching of the firm's *resources* and *capabilities* to the opportunities that arise in the external environment, research has placed increasing emphasis on the roles of resources and capabilities (Grant, 2008, p.125). In discussions of corporate strategy since the 1980s, attention is commonly given to "*the resource view of the firm*" and "*the positioning of the firm*". In Takagaki (2010a, 2010b), the formulation process of environmental strategy was analysed based on the positioning of the firm. In arguments based on the resources of the firm, the knowledge of the firm is considered the most important element.

One of the most important challenges firms are currently facing is the environmental issue, an issue that necessitates complex problem solving. Firms must now struggle not only with solving complex problems but also with developing a corporate management strategy having built-in capacity for actualization of environmental problems.

In this paper, following a review of knowledge management, discussion will address knowledge management in environmental strategy, based on case studies undertaken by the author.

RESOURCE-BASED VIEW (RBV) AND KNOWLEDGE MANAGEMENT (KM)

Within the field of management strategy, for over two decades there has been increasing interest in determining the features that enable firms to adapt to changing conditions. In this section, the two most prominent points of view are introduced briefly, based on Grant (2008, Chap.5).

RBV (Resource-based view)

In the early 1990s, recognition of the roles of resources and capabilities caused them to be seen as

the principal basis for firm strategy. Thus the primary source of profitability coalesced into what has become known as the *resource-based view of the firm* (Kogut and Zander, 1992; Grant, 1996). Yet, when the external environment is in a state of flux, the firm itself along with its bundle of resources and capabilities may be a much more reliable and stable basis on which to define the firm's identity (Hansen et al., 1999). A firm that can successfully confront both strong environmental movements and market competition may provide a good example. The firm-specific capabilities can then be seen as potential "roots of competitiveness," the source of new products, and the foundation for effective strategy (Spender, 1992; March, 1991). In general, the greater the rate of change in a firm's external environment, the more likely it is that a secure foundation for long-term strategy will be found in the internal resources and capabilities of the firm.

The resource-based view emphasizes the uniqueness of each company and suggests that the key to profitability is not through doing the *same* as other firms, but rather through exploiting *differences*. Establishing competitive advantage involves formulating and implementing a strategy that enhances and effectively utilizes the uniqueness of a firm's portfolio of resources and capabilities. Individual resources do not of themselves confer competitive advantage; rather, they must be coordinated and must complement each other in order to create a composite capability, more specifically the *organizational capability* of the firm (Barney, 1997; Grant, 1991).

KM (Knowledge Management)

The expression "knowledge management" refers to the processes and practices through which organizations generate value from knowledge. Academic interest in the role of knowledge within organizations can be seen by the influence of research streams including the *resource-based view*, economics of information, epistemology, evolutionary economics, and the management of technology. The outcome of integrating this variety of approaches has become a *knowledge-based view of the firm* that considers the firm as a set of knowledge assets, and that the role or purpose of the firm is to

deploy these assets to create value.

It can be said that knowledge management is effectively organizational learning, as reflected in “the move of best practice” and “management of intellectual assets,” and so on. When resources are considered, knowledge is overwhelmingly seen to be the most important productive resource. From a strategic viewpoint, knowledge is a particularly interesting resource: many types of knowledge are scarce, much is difficult to transfer, and complex forms of knowledge may be very difficult to replicate. Capabilities may be viewed as a manifestation of the knowledge of the organization. Thus the study of knowledge management offers valuable tools for creating, developing, maintaining, and replicating organizational capabilities.

(1) Types of knowledge and knowledge processes

The single most useful contribution of knowledge management is the recognition that different *types* of knowledge have very different characteristics. For example, the tacit/explicit distinction has important implications. However, knowledge management is also concerned with identifying and understanding the *processes* through which knowledge is developed and applied. Two categories of knowledge processes have been recognized: those that are concerned with increasing the stock (generation) of knowledge available to the organization, and those that are concerned with application of the organization's knowledge.

Within these two broad areas, a number of different knowledge processes can be observed, each of which has been associated with particular techniques and approaches to knowledge management. Grant (2008, Fig.5.10) provides a good summary of this, and others have similarly identified two major approaches. Spender (1992) uses the labels “knowledge creation”, and “knowledge application”, while March (1991) identifies “search (exploration)” and “use (exploitation)” (Leonard, 1996; Leonard and Sensiper, 1998).

The degree of interest in this area is revealed by the variety of labels used: “knowledge creation” and “knowledge acquisition” are identified within “knowledge creation (‘research’)”; and “knowledge integration”, “knowledge sharing”, “knowledge imitation”, “storage and organization of knowledge”,

“measurement of knowledge”, and “recognition of knowledge” are identified within “application (‘practical use’) of knowledge.”

(2) Conversion of knowledge and Nonaka's model

Within knowledge generation, it is possible to distinguish between the internal creation of knowledge (*knowledge creation*) and the search to identify and absorb existing knowledge from outside the organization (*knowledge acquisition*). In the systematic knowledge-creation model of Nonaka, and in that of others, knowledge is identified as being either tacit or explicit, with “new” knowledge being created by changing (“conversion”) and/or by continual and often mutual transfer between individuals and groups within, and including, the organization.

Nonaka's model of *knowledge creation* identifies the processes of knowledge conversion – the shift not only between tacit and explicit knowledge, but also between individual and organizational knowledge – and identifies these processes as being central to the organization's development of its knowledge base. In Nonaka's model, the conversion of knowledge according to different knowledge-types (the “epistemological dimension”) and knowledge-levels (the “ontological dimension”) forms a knowledge spiral which represents how the stock of knowledge broadens and deepens. This theoretical representation (which visually is reminiscent of the genetic double helix) is identified as Nonaka's “SECI-Model” in Nonaka (1993) and is referred to as such in Nonaka and Takeuchi (1995).

In brief, explicit knowledge is *internalized* into tacit knowledge in the form of intuition, know-how, and routines, while tacit knowledge is *externalized* into explicit knowledge through articulation and codification. Most importantly, the SECI model symbolically represents the exchange of such tacit knowledge and explicit knowledge, and the process of knowledge movement. This has been explained as Nonaka's Spiral of Knowledge Creation in Nonaka (1993).

Formation of Eco-Management Strategy

(1) Environmental Management

(Eco-management) Strategy

Environmental issues in the 1990s contributed to changes of social trends, and that combination

brought about significant change in the external factors affecting companies. It has now become a major strategic issue to consider how to deal with environmental aspects in company activities, including procurement of raw materials, methods and location of manufacturing, packaging, transport, promotion, sales, disposal, etc. Clearly, the significance of environmental management strategy has increased greatly since the 1990s, particularly if we see it not only as a response to environmental issues, but as efforts to anticipate environmental issues, and as an integral feature of all corporate strategic projects.

When a company operates primarily in pursuit of profits, it is likely to confront environmental (or *ecological*) problems. The corporate activity of reducing environmental impacts is often termed environmental strategy. However, in order to be both profitable and sustainable, an environmental (or *ecological*) management strategy means developing and maintaining a long-term vision, making decisions continuously, intentionally, and conscientiously in conjunction with the achievement of a business purpose, putting viable corporate principles into action, and managing and carrying out an enterprise successfully along the lines of its basic policies.

(2) Model of Eco-Management Strategy Formation

A company that develops strategies to deal with such external changes does so according to a sequence of steps. This 'life-cycle' of the company's strategy consists of four periods – introduction, execution, continuity and stagnation – which can be seen as the progressive stages of an environmentally related business problem being transformed into strategy.¹⁾ Takagaki (1998, 2010a, 2010b) presents this conceptually by showing the various inputs contributing to creation of an environmental strategy, as can be seen in Takagaki (2010a, Fig.2), and in Takagaki (2010b, p.60 Fig. 4-3).

First, the '*introduction period*' is the time within which a company embarks on a specific environmental measure, although its preparation is not always fully completed within the company. In the '*execution period*' for that specific environmental measure, the company's environmental approach is not yet broad or holistic. The '*continuity period*' is

the time of adherence to specific environmental measures, and during that period the company accumulates experience through its implementation. Lastly, the '*stagnation period*' is when the specific environmental measure has become a routine operation, little if any "new" experience accumulates, and strategic activities tend to diminish or slow down. After this '*stagnation period*', the activities will either attenuate to the point of disappearance or they will become fossilized within on-going strategy.

In the 1990s, because public concern highlighted environmental issues, circumstances of altered external conditions caused companies to direct strategic attention towards environmental measures. This is represented in the 'introduction' and 'execution' periods of environmental strategy. Market conditions being tough, the implementation of environmental measures became necessary for company survival. In the late 1990s, more and more companies were implementing environmental measures, indicating the start of the 'continuity' period. Changes in external conditions at this time included (i) prevalence of environmental management systems (ISO 14000 Series certification) (Horiuchi and Mukai, 2006), (ii) spread of environmental reporting and (iii) establishment of environment-related laws.

(3) Knowledge management in the formation model of eco-management

The development of a "strategy" within a particular company is noticed by the transformation from individually acquired and maintained "knowledge" to a more broadly based "organizational knowledge". That is, by paying attention to factors affecting internal features of a company, such as information flow, it is possible to observe the effect of a "manager's leadership."²⁾ In simple terms, a manager's undertaking of relevant steps of leadership is indicative of the manager's having recognized the necessity of performing an environmental strategy, and the steps undertaken reveal something about the manager's awareness of factors external to the company. At the most basic level, leadership is simply the act of taking notice of the discrepancy between the knowledge inherent to the organization and the knowledge needed to respond appro-

propriately to external factors. To be effective, the leadership must also have current knowledge of the organization's own structures and internal factors that can both enable and sustain the development, dispersal, and maintenance of knowledge.

First, in the *introductory* period of eco-management strategy, the manager who perceives certain external factors, and understands that they are related to an environmental problem, directs the introduction of an eco-management strategy into the company. The accumulation of knowledge corresponding to the environment is initially nascent within a company, but it progresses to the stage of obtaining new knowledge from the outside. Over time, tacit knowledge is replaced by explicit knowledge, and if the management during this research period is adequately organized for enabling a certain degree of integration, then sharing and imitation is initiated throughout the entire organization. Knowledge associated with, and corresponding to, environmental issues becomes established in the organization and subsequently progresses from being the concern of an individual or a group to being a concern integrated throughout the organization, enabling resources and capabilities to increase so that a concrete eco-management strategy can ultimately be successfully carried out.

Next, during the *execution* period of eco-management strategy, it is the persistence of external factors, outside the company, which causes a manager to direct the execution of an eco-management strategy. Within the company, the injection of various management resources takes place, enhancing the acquisition of new knowledge from outside of the firm. As a consequence, there is acceleration in the shift from tacit to explicit knowledge, as well as in the transformation of knowledge. As both knowledge and awareness of the environmental connection deepens and expands throughout the business organization, that knowledge/awareness moves beyond the domain of research or confinement to a segment of the company to become instead the foundation of systematic activities performed throughout the company. It is at this point that a concrete environmental strategy comes into existence. That strategy is then performed repeatedly and continually as a natural and mutually supported activity of the organization.

Subsequently, in the *continuity* period of an eco-management strategy, environmentally related external factors not only persist, they increase, causing the particular manager to direct the explicit strengthening and visibility of the company's environmental strategies. Needless to say, whenever there is injection of various management resources, additional, newer knowledge is obtained from the outside. Again the replacement of tacit knowledge by explicit knowledge is broadened and accelerated.

If the company establishes within the business organization the existence of a special section concerned with the maintenance of an eco-management strategy, this can result in increased integration, sharing, and imitation of knowledge, with the result that the day-to-day business operation in the organization is pervasive and regulated, and a concrete eco-management strategy comes into being as if it had always been part of the usual business management. During this progression from the introductory period of what ultimately becomes an eco-management strategy, moving through the execution period and then into the continuity period, the conceptual dimension of the form of the organization reveals a spread of knowledge and influence flowing from individual/group/organization, but not simply a unidirectional flow. This is what affects changes in the shape, speed, and spread of the spiral of knowledge, altering the shift between explicit and tacit knowledge. This process is configured as one of the applications of Nonaka's Spiral of Knowledge Creation in Nonaka (1993).

Methodology

Case studies were carried out based on surveys,³⁾ including interviews, given to three Japanese companies belonging to the electronics-related industries. Selected for the analysis were Canon, Ricoh, and Toshiba.

The reasons for selecting electronics-related industries for these case studies are their (1) high prospects for strategy formation, (2) feasibility for consideration of plastic waste and recycling, (3) feasibility for application to other industries, (4) condition of being actively growing industries, (5) existence of (or potential for) active overseas operations.

Table 1. Brief summary of three firms

	Canon	Ricoh	Toshiba
Profile of firm	Manufacturer of Optical apparatus (i.e., camera), Computer-related peripherals, and IT-related apparatus (i.e., copying machines and printers)	Manufacturer of Business machines (copying machines, IT-related machines and equipment)	Manufacturer of Electronics and Engineering
Top Mgmt.	1985, Ryuzaburo Kaku 1990, Keizo Yamaji 1995, Fujio Mitarai	1986, Hiroshi Hamada 1996, Masamitsu Sakurai	1988, Jyoichi Aoi
<i>Introductory period</i>	1988, <i>Kyosei</i> (living together with the environment) 1989, toner-cartridge recycled in Dailian, China. Leadership by Yuuzabro Kaku & Keizo Yamaji	1980s, "green club" among managers does not work 1992, R&D outcomes 1992, Ricoh UK Product won the Queen's Prize	1988, organisational structure for environmental measures 1989, Environmental Technical Laboratory in Research Centre 1989, Environmental Committee
<i>Execution period</i>	1990, recycling company established in Japan, recycling all parts of the toner-cartridge	1990s, environmental measure in domestic and overseas 1996, Masamitsu Sakurai	Management of a research organization and accumulation of various kind of technology
<i>Continuation period</i>	1995, Fujio Mitarai, cost-cut 2000 tones down activities, strategy stable. Recycling operation center in Ibaraki Prefecture	During 2000s, top rankings environmental management	2005, Atsutoshi Nishida
<i>Current situation</i>	<i>Stagnation period</i> before new environmental strategy.	Announced the 2050 Environmental Vision (new environmental strategy)	Innovation activity called "i cube", close collaboration of the development and manufacturing and sales departments; plans for contributions to global environment in 2050

Based on surveys and interviews, analysis was made of environmental strategy of the selected companies for the three periods of "introduction", "execution" and "continuity." Excluded from this study was the "stagnation" period for the reason that here focus of the analysis is on the formation process of environmental strategy. The framework for the analysis of strategy for those three periods (introduction, execution, and continuity periods) is explained below.

Contents of case studies

Provided here a relevant summary of the history and development of each company, its products, its leadership, its public image, and its response to environmental issues. Table 1 provides a brief summary of the three firms (Canon, Ricoh, and Toshiba).

(1) Canon

Originally, Canon was a manufacturer of optical apparatus (such as cameras). The company has subsequently become one of Japan's leading manufacturers of computer-related peripherals and IT-related apparatus, including copying machines and printers. In 1975, Canon pioneered the development of LBP and subsequently in 1981 developed the bubble-jet printing method (IJP: ink jet printer in Canon). Currently, both LBP and IJP are sold by Canon.

Since the 1985 appointment of Ryuzaburo Kaku as president of Canon (with Keizo Yamaji serving as vice president until assuming the presidency in 1990), the company has established its business philosophy, including adoption of the expression *Kyosei* ("living together with the environment") in 1988. The decision was made internally as a consequence of planning the addition of a recycling

process for its new toner-cartridge manufacturing plant, which was to be built in Dailian, China. Collection of cartridges for recycling was started already by 1990 and operation of the recycling department and the related manufacturing department started in 1991. It should be remarked that this was an extraordinarily rapid development as it normally takes at least 2-3 years to establish new facilities, from site selection and plant design to construction and operation. The rapidity of this move was expected to enable Canon to secure substantial advantage over other manufacturers in the growing market for laser beam printers (LBPs), fax machines and photocopiers.

In 1990, a recycling subsidiary company was established in Japan to enable the recycling of all parts of the toner-cartridge. Additionally, recycling was also started for both the heat-sensitive-drum and the expended waste toner of the copy machines, and by the end of 1990 the recycling of the main parts of the copy machine had begun.

As can be seen, the *introductory period* for Canon's environmental strategy started in 1988, and quickly progressed to the *execution period* in 1990. The *continuation period* could be identified as beginning as early as 1991, with the development of recycling technologies and construction of a plant, or it can be associated with 1997, when the collection area for recycling was expanded.

After Yamaji completed his service as president (the chairman was then Kaku), followed by the sudden death of Hajime Mitarai (son of Canon's founder Takeshi Mitarai), in 1995 the presidency went to Fujio Mitarai (cousin of Hajime). Fujio Mitarai turned his attention to cost cutting, attempting to obtain it through employment of temporary workers and improvements of production efficiency. Therefore, around 2000, Canon's environmental activities appear to have toned down somewhat; nonetheless, its environmental strategy progressed steadily since the 1990s under the policy that implementation of environmental measures should lead to cost reduction, so there has been no inconsistency.

In the domestic market in the 2000s, the recycling operation center in Ibaraki Prefecture, near Tokyo, played a major role as a center for recycling. By then, throughout the world, Canon was operat-

ing production and sales of individual-usage copying machines. For both environmental preservation and effective use of materials, Canon has been working steadily from recycling to reproduction and/or reuse.

Canon's leadership is clearly established by the fact that in and around 1990, patent applications by Canon were strikingly numerous as compared to those of other companies of the high-tech industries, as well as those of Canon's immediate rivals in the same industry. Also, communication increased rapidly with the major materials and the precision machinery component manufacturers, parts suppliers.

Although Canon's major R&D (research and development) was originally done at the head-office, which was then located at their Shimo-Maruko plant site in Tokyo, the technical development was distributed to major production sites in Ibaraki (the Torite and Ami plants) and in Tochigi (the Utsunomiya plant). In commercial production, the knowledge and know-how needed for every product must be integrated, and successful duplication and replication of such knowledge was needed for the new and large-scale production site at the Oita plant and for the overseas production sites, which had volume-production facilities. Development of new products, and subsequently market entry as well as recycling, could be attained only after sharing and transferring knowledge among these organizations if the company was to perform smoothly and successfully.

Throughout the 2000s, as indicated by the annual evaluation presented by *The Nikkei* (*Nihon Keizai Shinbun*, an economics newspaper), Canon's environmental management has remained in the top rankings of the manufacturing sector, indicating that its environmental strategy has remained in a stable *continuity period*.

If long-term measures and the recycling of main units (as well as components) are considered as new environmental strategy for Canon, then the time around 2000, when Canon kept a low profile about its environmental approach, can be regarded as a *stagnation period* before the introduction of *new environmental strategy*.

(2) Ricoh

Ricoh makes business machines, primarily copying machines and other information machines and equipment, and continues to perform well steadily, in step with its response to environmental problems.

Evidently Ricoh started early: already in 1975, Ricoh's "environmental promotion room" was set in its factory for aiming at environmental measurements. Although Ricoh carried out the theme of confronting environmental problems by means of social gatherings, such as the manager's study meetings ("the green club") and the establishment of an officer class, beginning in 1980s, Ricoh failed to proceed to a company-wide movement before the end of 1990s.

Therefore, for Ricoh, the effective *introductory period* can be seen as taking root comparatively late, perhaps 1990. Although Ricoh's decision on environmental strategy was not made until the end of 1990, about three years later than Canon, Ricoh nonetheless put every effort into research and development, and consequently has rapidly achieved substantial outcomes since 1992. The company evinced a sense of emergency regarding whether it was able to secure the position of the largest seller of photocopiers in the domestic market. Ricoh was at the time struggling with sales expansion in the European market because it did not have the environmental mark (Blue Angel) in Germany due to delay in tackling environmental issues.

Although in Japan, Ricoh had not yet been able to provide a clear environmental strategy, good news came from England, in 1992, when a Ricoh subsidiary company (RPL: Ricoh UK Products, Ltd.) won the Queen's Prize because of their contribution to environmental measures: CFC (chlorofluorocarbon) abolition, and the recycling of resources. Headquarters in Tokyo immediately decided that their policy should be for environmental measures to be spread through domestic plants, and then on to overseas plants.

Despite its late entry, Ricoh therefore advanced quickly to an *execution period*. As an example of environmental considerations evident in product design, there was a significant reduction of the number of screws used in construction of a paper-tray for their copy machine. The number was re-

duced from 20 screws in 1989, to 2 screws in 1993. A large number of screws not only delayed the time need for assemblage, it also unnecessarily complicated the decomposition work, reassembly, and recovery of parts-and-materials. Reduction in the number of screws was effective for both environmental preservation and the cutting of costs.

The technical matters of reduction and reuse of plastics, however, were rather complicated. There were many resins, pigments, and additives to be considered, along with concerns of maintaining the intensity of the resins, which deteriorated over time, and maintaining fire-retardant capabilities. However, as a result of successful bilateral talks and co-operative work with resin makers, ultimately only 2 kinds of resin came to be used in the main body of Ricoh's copy machine.

For such technical reasons, the problem of identifying the beginning of Ricoh's *continuation period* of environmental management is similarly complicated. For Ricoh to succeed in building a fully recuperative system including dismantling and crushing of parts, providing the basis for reproducing a new product from recovery of the outworn product, it was necessary to develop an entire recycle system (the "comet circleTM"), which was ultimately started with the co-operation of suppliers and users. It was necessary to dismantle the equipment, classify and sort the parts, and reuse the metal parts. Customer companies and companies specializing in recycling became involved. With the life of a business machine being about 5 years, recycling considerations had to be incorporated into the design as early as 1993 in order for the implementation of full-scale operation, including recycling, to begin from 1998.

Another factor to consider is that Masamitsu Sakurai became president of Ricoh in 1996, replacing Hiroshi Hamada. This was an unprecedented appointment because previously there had been no president with a background in engineering. However, under Sakurai's leadership, environmental strategy was pushed forward significantly because of Sakurai's having previously obtained long years of experience while working in Europe for a subsidiary company (PPL) in the UK. There he became thoroughly acquainted with the impact of environmental awareness and preservation on conditions in the European market.

As for the current situation, even during the 2000s, Ricoh has maintained a high position next to Canon in several environmental management rankings of the manufacturing sector. In the 2005 environmental report of *The Nikkei*, Ricoh ranked high in four measurements for comparative value: environmental preservation costs, economic effects, environmental preservation effects and environmental impact, measurements which are regarded as the most sufficient environmental accounting information (Amano et al. 2006; p.180). As for the current situation, Ricoh has announced its 2050 Environmental Vision, and it is fair to say that the company is now entering the introduction period for the next, *new environmental strategy*, beginning from within the continuity period of the old environmental strategy.

(3) Toshiba

Toshiba is an engineering and electronics multinational corporation headquartered in Tokyo, Japan. The Japanese firm Toshiba was founded in 1939 as Tokyo Shibaura Electric K.K. through the merger of Shibaura Seisaku-sho (founded in 1875) and Tokyo Denki (founded in 1890).

In 1988, Toshiba began working on organisational structure for environmental measures, while Jyoichi Aoi was president, and in 1989 established an Environmental Technical Laboratory in a research center, implementing staff exchanges between the research center and the factories.

The concept of the Environmental Technical Laboratory derived from the strong will of President Aoi, whose belief was that the production of core technology by a factory that excelled in environmental preservation was essential for Toshiba's continuation in business. The Environmental Technical Laboratory consists of three sections (Environmental Technology, Materials Application, and Environmental Technology Planning), originally with a staff of 60 (later increased) and an annual budget of 2 billion yen (10% of the Research Centre budget). The aims of the Environmental Technology section (with a staff of about 30) were the development of technology concerning environmental preservation: chlorofluorocarbon alternative washing, decomposition of the chlorine system organic solvent, specific environment analysis, and so on.

The Materials Application section (with a staff of about 40) was to perform database construction of assay technology, materials (semiconductors, material, etc.), and chemical substances. The Environmental Technology Planning section (with a staff of 4) was responsible for assessments and planning, including projecting future issues concerning environmental problems, and advanced technical development useful for environmental preservation.

Environment-related activities were carried out by an organisation separate from the line organisation, as evident in the certifying of environmental auditors from a staff dedicated to environmental management. Operation by a different organisation is a common method, which has long been applied to plant safety inspections or small group activities. Such company-wide organisational structures for the deployment of environmental management have been the basis of a very strong foundation for developing strategy for the entire corporate group.

Toshiba was implementing a shift from the manufacture of heavy electrical and home electrical appliances to energy and electronics (E & E) as its core business. In the midst of tough market competition, Toshiba had to proclaim its motto "Commitment to people, commitment to the future." Actively working on environmental issues was believed to become the company's source of strength for maintaining competitiveness over its rivals.

Under strong leadership from top-level management of President Aoi, the management of the research organization, along with significant technical accumulation, made a large contribution to the formation of Toshiba's environmental strategy in both the *introductory period* and *execution period*. The successful, long-term management of a research organization and the accumulation of various kinds of technology have together played a substantial role in the organization.

Under the leadership of Atsutoshi Nishida, who succeeded to the position of president in 2005, Toshiba continues to be regarded as being generally successful about business restructuring and efficiency improvement, which were started during the last half of the 1990s. At present, the company is carrying out an innovation activity called "i cube" to multiple the effects through close collaboration of the development, manufacturing and sales de-

Table 2. Knowledge Creation in three firms' Environmental Management

	Canon	Ricoh	Toshiba
Individual ↓	Optical/Electronics know-how ↓	Optical/Electronics know-how ↓	Knowledge (tacit/explicit) ↓
Group ↓	RBP, and Inkjet technology ↓	Copy machine technology ↓	Small-group activities ↓
Organization ↓	Printer and equipment RBP, and Inkjet printer ↓	Coordination of divisions Reducing resin and screws ↓	Environmental Technical Laboratory ↓
Inter-Organization	Own product & OEM	<i>Comet Cycle</i> ®, with supplier	Environmental Management Technology Planning
Strategy Formation	1989, toner-cartridge recycle 1990, recycling company 2000s, recycling center	1992, Ricoh UK (PPL) 1990s, environmental measures	1989, Environmental Technical Laboratory 1990s, environmental measures

partments, aiming to continue “sound growth and profit” in business for both domestic and overseas operations, based on the foundation of its organisational strength. Under the belief that sustainable growth as “a corporate citizen of planet Earth” is feasible only when the social existence value of a company is recognised, Toshiba has been intensifying corporate social responsibility (CSR) activities covering global environment preservation, social contributions and compliance.

The 2008 version of the company's environmental report amounts to about 70 pages full of substantial information. Announcing its “Environmental Vision 2050” in November 2007 to illustrate the goals to achieve by promoting the environmental management of the Toshiba Group, the company has initiated activities for placing it at the forefront of contributions to global environment, for respecting the diversities of countries and regions, and for creating new values. As for the **current situation**, Toshiba is shifting to its **new environmental strategy** with goals set for 2050.

ANALYSIS

Progression of strategy formation

From the result of three case studies, the progression of strategy formation, based on knowledge creation, is summarized in Table 2.

(1) Strategy introduction period

As for factors outside the companies, it can be seen that during the strategy introduction period, “mar-

ket competition” and “social trends (environmental issues)” influenced all three companies, Canon, Ricoh, and Toshiba, around 1990.

As for factors inside the companies, “administration of research organisation” and “accumulation of skills and technologies” reflect the potential for technological resources. Both factors heavily influenced all three companies similarly.

For Canon and Toshiba, the substantial influence of “top-down management”, rather than “management's leadership”, is a noticeable feature. Management of Ricoh (Hamada, H.) was not quite the top-down management type, but Hamada is assumed to have been a strong supporter for development of environmental technologies as is indicated by the fact that the budget for research and development was not reduced in 1992 despite Ricoh's operating profit being then not merely non-existent, but absolutely in the red.

(2) Strategy execution period

Carried over from the strategy of the introduction period, again in the execution period “social trends (environmental issues)” and “market competitions” had a strong influence on the three companies. In the 1990s when market competition was fierce, environmental issues drew attention, causing those companies to be aware that the handling and control of waste and the recycling of information equipment became not simply essential duties for companies but also opportunities to bring about increased market competitiveness.

As for internal factors, “management's leader-

ship” continued to be influential. Moreover, the influence of “managerial resources” and “foundations for organisational activities” was noted for all the companies.

(3) Strategy continuity period

As external factors, “social trends (environmental issues)” and “market competition” had an influence on all three companies, particularly in the strategy introduction and execution periods. In addition, the influence of “environmental management”, “spread of environmental reporting” and “establishment of environment-related laws” was substantial.

As for internal factors, “management’s leadership” continued to give a strong influence in the cases of Ricoh and Toshiba. Additionally, “input of managerial resources” and “foundations for organisational activities” influenced all the companies.

The “strategy continuity period” generally started in the 2000s and the companies’ environmental measures had been widely established by then. Nonetheless, the companies have become divided between those noteworthy for their new strategic activities and those that are scarcely noticeable.

Opportunities for strategy formation

As seen in the case of Canon and Toshiba, if the management leadership of a company is strong and if top-down management takes place, not only will the formation of technological strategy be accelerated, but also the strategy will permeate faster throughout the entire company, shortening the time needed for establishing business strategy. This is because top-down management makes the direction of strategy clear, reducing resistance inside the company and quickening a launch of strategy from introduction to execution. Such top management can be identified as transformational leaders,⁴⁾ who can point their company in the right direction in times of substantial changes of the external environment.

For the strategy introduction period driven by top-down management, if there were senior executives who were sharp-eyed about both industry competition and the trends in environmental issues and if those leaders were able to recognize the ur-

gency of the situation and were also able to successfully communicate to others a sense of emergency, they could therefore more readily initiate the development of environmental technologies. This is clearly seen in the examples of Canon around 1990, during the time of President Ryuzaburo Kaku. Similarly, this can be seen in Toshiba during the time of President Joichi Aoi. Both presidents exercised transformational leadership at those particularly critical times and they also displayed great interest in other activities, as well, not just environmental issues. This is especially true in the case of Ryuzaburo Kaku, the president of Canon, who was appointed through internal promotion and was taking over the position of his predecessor, who had been a member of the founding family; he needed to show firmness in his grip of the corporate organisation, and thus he was driven to activate his employees’ morale. Such leaders had to satisfy and maintain cohesion among their internal audience while exhibiting to an external audience their ability to provide reliable, responsible, and progressive leadership. Canon and Ricoh are highly technology-oriented companies with substantial knowledge accumulation and both benefited from established organisational structures for technological control and operational control.

Nevertheless, even with the absence of top-down management, some companies could enter into the strategy execution period after a successful introduction period, and Ricoh is an example of such a case. For Ricoh, market competition around 1990 was a significant defining factor. The company’s work on development of environmental technologies did not start quite as early as some manufacturers such as Canon and Toshiba, which were already ahead in the field; moreover, the photocopier and printer industries were experiencing enormous reform and very tough competition in the product market. Before President Sakurai was appointed, Ricoh had no strong management, but under sympathetic management (Hiroshi Hamada), a sense of emergency and activity seem to have grown due to the presence of other companies with unique senior executives in the industry, such as Canon with Ryuzaburo Kaku.

In companies where top-down management had a pronounced influence, the retirement of their

leading executives effected a slowing down of the companies' strategic activities, at least as it might appear to outsiders. However, in the strategy continuity period following the retirement of top-down management type leaders, steady activities have continued inside the companies and it is noteworthy that it is at those times that tangible effects are evaluated internally and recognised more highly. Canon and Toshiba around 2000 are prime examples of such a case.

As we have seen here earlier, the conditions and situations of those companies that became "environmental management strategic companies" vary considerably from company to company. Among the large Japanese companies that were early in introducing environmental management strategy, Canon and Toshiba are most typical among the three companies in the case study and can be identified as "pioneer companies" that broke new ground and led the way. Though Ricoh made a fumbling start, it caught up very quickly and subsequently became an "environmental strategic company" through its formation as a technologically advanced company.

It is of utmost importance to recognize that the race for development of environmental technology started under competitive conditions in the industry, and that environmental strategy formation spread among technologically advanced companies through the influence of pioneering companies. Electronics-related industries are mostly assembly-type manufacturing businesses, and many companies are related to one another through activities such as component procurement. Therefore, as seen in Ricoh's *Comet Cycle*[®], development of recycling technologies and the establishment of recycling systems could be set in progress through collaboration of the core company with business relations connected with material/parts supply or sales routes. Also, environmental management (certification of ISO-14000 Series) has become widespread through business-related networks (Katsuda, 2007; p.88). As seen above, due to inducement by some companies, competition for development of environmental technologies was created in the industry and continues to prevail inside and outside of the industry through various business relations. This implies the possibility, or probability,

of eventual transmission throughout the entire economy, along with subsequent changes that may transform the encompassing society and even spread beyond to those societies with which it does business.

Shift to new environmental strategy

In the midst of the second decade of the 21st century, the divide between the two types of companies is becoming clearer: some have the ability to shift to new environmental strategy through the use of accumulated managerial resources but others appear to lack such ability. Toshiba and Ricoh have been clear about their shift to a new environmental strategy, aiming for 2050, and also Canon has shown the ability to move towards new environmental strategy.

Since the onset of problems with subprime loans, recognized in 2007, the recession has significantly affected the industries, but cases similar to those of Toshiba and Ricoh may be found elsewhere and may ultimately grow in number. It is worthwhile keeping watch on how Toshiba, Ricoh and Canon evolve as they move from their currently existing environmental strategy into the new one, projected for attainment by mid-century.

CONCLUSION

This paper has presented the results of case studies of three Japanese companies, Canon, Ricoh, and Toshiba, undertaken for examining and analyzing the process of establishing environmental management strategy. Questionnaires and interviews were initiated in the mid-1990s and continued for nearly fifteen years, with future follow-up investigation currently in the planning. This paper has also over-viewed relevant research that has led up to this study, providing both inspiration and framework for analysis.

As for the progression of strategy formation, four stages of lifecycle have been suggested, and observed in these case studies: the periods of (A) strategy introduction, (B) execution, (C) continuity, and (D) stagnation. For each of the first three periods, influential factors on strategy formation were identified, and categorized as being either *external* (outside the companies) or *internal* (inside the companies), and a model of environmental

strategy formation was created. (Comparative discussion of the stagnation period (D) was not practicable.) Because the *external* conditions have already been analysed in Takagaki (2010ab), focus is primarily put on *internal* conditions. From the case studies, using the model of environmental strategy formation, the following are the observable effects of internal/external factors.

Two *external* factors are evident in, and affect all three analysed periods, the strategy-introduction/-execution/-continuity periods (A, B, C): (1) environmental issues as a social trend, and (2) market competition. For *external* factors during the strategy continuity period (C), three additional factors are observable: (3) prevalence of environmental management system (certification of ISO14000 Series), (4) spread of environmental reporting, and (5) establishment of environment-related laws. In total, there are five observable, relevant external factors affecting the progression of strategy formation.

As for significant *internal factors*, a total of six are observable. During the strategy-introduction period (A), the three significant *internal* factors are (i) management leadership, (ii) administration of research organisation, and (iii) accumulation of technologies and skills. During the strategy-execution period (B), the factors are: (i) management leadership, (iv) managerial resources, and (v) foundations for activities within the organisation, including creation of informal organisations. During the continuity period (C), the factors are: (i) management leadership, (iv) sustainable managerial resources, and (vi) structure of specialist organisations.

It is noteworthy that the most significant *internal factor*, occurring in all three active stages (A, B, C) of strategy-formation lifecycle, is (i) management leadership. The second-most significant internal factor, relevant during both the execution and continuity stages (B, C) is (iv) managerial resources.

Also noteworthy is that management leadership (such as exhibited by Canon and Toshiba, companies with top-down management, or transformational leadership) who were fully aware of environmental issues (=external factors), succeeded in enabling their companies to become “pioneer com-

panies” (environmental management strategic companies) at very early times. Yet, even without top-down management, if the industry experienced strong market competition, “technologically advanced companies” with accumulated technological assets could become environmental management strategic companies under supportive management, such as in the case of Ricoh, which may be an example of “middle-up-down management” (mentioned in Nonaka 1988; Nonaka and Takeuchi 1995).

As indicated, technology accumulation and organisational background are observably key factors. This means management possesses relevant information related to eco-management strategy for all three companies, Canon, Ricoh, and Toshiba. Additionally, there were several different routes for the companies to take to become an “environmental management strategic company” having high ability to cope with environmental issues and exhibiting a very proactive attitude.

It is worthwhile noting that not all companies were able to embark on a shift to new environmental strategy with a long-term and holistic approach to environmental issues, such as achieved by Toshiba and Ricoh. Possible reasons for Canon being unable enter into new environmental strategy, even though it is highly technological, are (1) the top-down manager retired, (2) the capability of the organization weakened or has not yet recovered.

As already mentioned, the significant influence of knowledge management in the formation of an eco-management strategy has been verified. Nonetheless, it is difficult to recognize in the early stage precisely where and to what degree the knowledge of individuals contributes in a business organization. These and other matters are topics to be considered in future interview-type investigation.

NOTES

- 1) Refer to Takagaki (2010b), pp.60-61.
- 2) As for the leadership of top management, refer to Takagaki (2010b), pp.108-122.
- 3) Questionnaire surveys of companies’ environmental measures were conducted four times: in 1995, 1999, 2002 and 2007. The early, prelimi-

nary questionnaires contained a wide range of questions for the purpose of assessing the existent situation, but year-by-year the exploratory questions were refined to address more specific items. During those same periods, interview surveys were continuously undertaken supplementary to, and in support of, the questionnaire survey.

- 4) Transformational leaders are top executive officers who are capable of precise and sensitive understanding of current situations and who are also responsive and skilled in the exercise of judgment and necessary adjustments for establishing corporate policies suitable for substantial changes of the external environment (Kanai, 2000) (Kase et al., 2005).

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