Investigating the emergence of innovative green technologies using the causal texture model: The effect of Japanese cultural values

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Abstract - Previous studies suggest that humans have significantly upset the balance between nature and society and that people should realize the impact of their activities on nature given the repercussions of global warming for the world at large. Simultaneously, business organizations are under increasing pressure to proactively contribute to a sustainable model that minimizes harm to the world. This study examines innovative green technologies that have emerged in response to this social demand. It applies the causal texture model and examines green technology emergence using discourses from Japanese firms. It further focuses on the Japanese cultural values of mitomonai and mottainai (both relating to the avoidance of undesirable actions) and their role in the learning process of collective causal beliefs. Finally, we present an amended causal texture model to more positively account for the natural environment and to clarify the interdependence between organizations and the environment.

INTRODUCTION

These In 2011, a mega earthquake in the Tohoku region of Japan generated a tsunami that disrupted the supply chains of firms (e.g., in the automobile industry) and paralyzed socioeconomic activities. Simultaneously, an accident caused by the tsunami at the Fukushima nuclear power plant had severe health repercussions for the local population, creating great anxiety among the Japanese people and disrupting economic activities, with the effects continuing to persist even today. This series of disasters caused the Japanese to acknowledge the unpredictable ways of nature and the potential danger this entails. In addition, abnormal weather caused by climate change has affected both society and the economy. The artificial discharge of carbon dioxide has been aggravating global warming and abnormal weather (IPCC, 2007), as well as causing other serious problems. There is a limit to the extent to which humans can control environmental conditions and natural resources (Meadows et al., 1972). Humans have upset the balance between nature and society (Senge, 2006). People should realize the impact of their activities on the natural environment in light of the “awesome prospect” of global warming (Giddens, 2011).

Accordingly, modern firms should reconsider the 20th century model of mass production, mass consumption, and mass disposal. Faced with the increasing social demand to adopt a sustainable model of economic growth that minimizes harm to the world (Boulding, 1966; Hawken, 1993; Pauli, 1995; Hawken et al., 1999), firms are expected to proactively contribute to a new model (Porter, 1991; Porter & Linde, 1995a; Porter & Linde, 1995b; Sharma, 2000; Jennings & Hoffman, 2016). This means not only reducing the environmental burden of traditional manufacturing businesses, but also creating new businesses that protect the environment (Kimata, 2013). Some organizational studies have discussed solutions for environmental problems, such as those based on the eco-biosphere view (Shrivastava, 1994), institutional theory (Wijen & Ansari, 2006), and a socioeconomic regimes approach (Wittneben et al., 2012). However, few studies have elucidated the creation of new innovative green businesses from the meta-level perspective of interdependence between organizations and the environment. Accordingly, this study addresses the following research questions: 1) how does innovative green technology emerge in firms? and 2) what types of cultural factors affect the emergence of innovative green technologies? In considering these two research questions, this study mainly employs the functionalism approach, which is based on the objective dimension of regulation sociology (Burrell & Morgan, 1979) and the causal texture model (Emery & Trist, 1965; Emery & Trist 1973; Emery, 1977; Emery, 2000). The causal texture model broadly covers the interdependence between organizations and their environment from an abstract functionalism perspective. Further, we propose an
amendment to the causal texture model, such that it more positively incorporates the natural environment. Related to this, we investigate how public companies developed innovative green technologies that balance economic efficiency and environmental protection. Then, we focus on core technology, which Thompson (1967) indicated was a key factor in organizational continuation and growth, and its creation process. Core technology refers not only literally to the main technology a firm uses, but also to know-how or organizational strength (Thompson, 1967). Through discourses with Japanese firms, the study especially focuses attention on learning, which is the process of developing or changing collective causal beliefs (Axelrod, 1976). We highlight the main societal and environmental factors, as well as Japanese cultural values, underlying the learning process. Finally, the study presents an assumption of the amended causal texture model, which clarifies the interdependence between organizations, the societal environment, and the natural environment.

2. PROPOSITION OF THE FRAMEWORK

To examine the causal texture model (Emery & Trist, 1965; Emery, 1977; Emery, 2000) upon which this study is based, we review the treatment of the natural environment in traditional organization studies prior to contingency theory. The reason we begin here is that previous studies of contingency theory inherently took a mainstream, functional approach to organizational studies. Afterwards, contingency theory was subdivided into post-contingency theories, for example resource dependence theory (Pfeffer & Salancik, 1978) or organizational ecology (Hannan & Freeman, 1977). Therefore, to examine the fundamental treatment of the natural environment, there is value in reviewing the study of contingency theory, which was broadly and commonly shared among functionalists.

Overview of organization theory for the natural environment

While Barnard (1938, 73) defined a formal organization as “a system of consciously coordinated activities or forces of two or more persons,” the forces themselves were defined as consisting of physical, biological, personal, and social elements. In addition, for the purpose of increasing the possible cooperation among the physical and biological factors, the concept of organization principally takes “the form of purposeful change of the natural environment” (Barnard, 1938, 54–55). Moreover, Simon (1945: 1976) and March and Simon (1958) argued for “bounded rationality” and “satisfactory standards” in decision-making. They pointed out that the opportunity for decision-making accompanied by innovation is dependent upon optimum stress being received from the external environment (March & Simon, 1958, 184). In this way, according to early organization theory, it appears that the environment was recognized as being a source of managerial resources or stimulation.

Based on these studies, contingency theory was established mainly in the 1960s and 1970s to investigate the relationship between organizations and the environment. This theory developed the “if—then” framework, according to which, “if the organization will adapt to its environment, then the organization can obtain a result.” The early theory assumed an organization had, as a goal, to act adaptively with respect to its environment. It proposed that organizational performance is mainly determined in the context of an organization’s degree of fitness to exist in the external environment (e.g., Burns & Stalker, 1961; Woodward, 1965; Lawrence & Lorsch, 1967).

Burns and Stalker (1961, 119–122) stressed there was a fixed relationship between the external environment and managerial systems. They observed the speed of technical innovation and market conditions in the external environment and indicated, “a mechanistic management system is appropriate to stable conditions,” while “the organic form is appropriate to changing conditions.” Lawrence and Lorsch (1967) focused on environmental uncertainty occurring in the external environment, with scientific technology, market, and economy as variables. They asserted that if environmental uncertainty increases, then organizational differentiation will occur, and organizations will develop an original managerial system or a method of conflict solution for gaining organizational performance through the integration of differentiated activities (Lawrence & Lorsch, 1967, 108). This early theory automatically assumed the interaction of an organization and its environment, without explaining the organizational action itself (Takahashi, 1998). Research by Lawrence and Lorsch (1967) created a new domain in organization theory, but it focused on specific environmental elements and did not broadly integrate the external environment.

Classification of the external environment

In later studies of contingency theory, Negandhi (1973) and Luthans (1976) were concerned more with comprehensiveness. Luthans (1976, 50) generalized the organizational environment into the internal (formal organization system) and the external (both specific and general). The specific environment (namely, the task environment) is constructed from the factors of competitors, suppliers, and customers; while the general environment is composed of technological, political/legal, economic, and social variables. Assuming all variables affect each other mutually, the variables of the specific environment affect organizations directly, while the factors of the general environment influence organizations both directly and indirectly. Negandhi (1973, 83) indicated the importance of classifying the external environment into the “task environment” and the “societal environment,” consisting of society, economy, politics, law, and cultural factors, which is similar to Luthans’ classification. Figure 1 shows the relationship between an organization and its environment when the environmental classifications are combined.
Luthans (1976, 66) argued the importance of natural resources as an economic factor in the general (societal) environment. As land is a limited resource, organizations are unable to control the price of natural resources, such as oil, copper, and silver. This indication meant that the uncertainty of the organizational environment would increase in the future. Moreover, for the political/legal variable, he stressed that “environmental regulations are going to have a much bigger impact on organizations in the future” (Luthans, 1976, 70). Incidentally, we could say the projection by Luthans predicted the complicated interdependence between organizations and the natural environment in modern times. However, contingency theory was dominated by environmental determinism (Takahashi, 1998); organizations were assumed to act passively and to accommodate the environment. The research acknowledged the relationship between the task environment and organizations. Thus, we note that the environment was treated as societal prior to contingency theory. To quote an argument of the sociologist, Boulding (1966, 9), the natural environment was treated as “reservoirs of raw materials.”

Given the above studies, why was the natural environment not dealt with sufficiently in previous views of contingency theory? First, we point out that the natural environment has been considered an infinite and stable factor, so organization theory restricted itself to “a given natural environment.” Second, we suggest that the environment has been conceptualized as something that brings uncertainty to organizations; therefore, the natural environment was ignored and researchers failed to incorporate it in the theory. At the beginning of this paper, we explained that natural disasters and abnormal weather worldwide have paralyzed socioeconomic activities and caused people much anxiety. In Japan, since the tsunami caused the nuclear power plants accident, the natural environment is no longer regarded as a stable factor. Meanwhile, from the ecological scientific viewpoint, the increased use of chemical substances, mass production, mass consumption, and mass waste in socioeconomic activity have together caused climate change, including global warming, and the contamination of soil, water, and the atmosphere (Carson, 1962; Ehrlich, 1968; Hardin, 1968; Commoner, 1971; de Steiguer, 1997). Subsequently, environmental protection regulations have been tightened in advanced nations, especially in the European Union. This means that the natural environment has strongly affected the societal environment.

**Framework of the causal texture model and its extension**

This study examines the causal texture model (Emery & Trist, 1965; Emery, 1977; Emery, 2000), which has been quoted and widely used in contemporary studies (Selsky & Barton, 2000; Herrmann et al., 2007; Barton et al, 2009; Neumann, 2010; Robey et al., 2013; McFarlane & Hills, 2013; Waterson, 2014; Greenwood, 2017) and open systems thinking (e. g., Selsky & Barton, 2000; Barton et al, 2009; St-Hilaire, 2013). Among these studies, some are positively based on the causal texture model but reconstruct or incorporate additions to create a new framework. For instance, Gloster (2000) extended the framework to “the core socioecological action research methodological perspective,” and Broekstra (2002) focused on “the modification of the taxonomy on the basis of synergetic,” bridging the gap between positivist science and action research by treating the framework as an ecological learning model (Barton et al., 2009). Selsky and Barton (2000) investigated the case of a New Zealand port, treating the framework as a “third track of open-systems thinking school.” However, these studies did not significantly consider the natural environment. Therefore, this study incorporates the natural environment into Emery and Trist’s causal texture model. In addition, we decided to include the societal environment and the natural environment independently into the causal texture model. To do this, we use subscript 2 to represent the societal environment, and subscript 3 to represent the natural environment. As a result, the relationship between an organization and its environment can be expressed, as shown in Figure 4. Organizations are configurations not only of the societal environment but also
of the natural environment. We suggest that current organization theory should reconsider the correlation of L13, L31, L23, and L32, in particular.

Furthermore, following Emery’s (2000) framework, this study examines organizational “planning” through innovative green technologies for both environments, defined by the relationships shown by L12 and the L13 in the model. However, innovative green technologies are based somewhat on the beliefs of organizational members, which may be affected by the societal and natural environments, namely “learning” as defined by the L21 and the L31 relationships. These four relationships are the main focus in this study (see Figure 5). The study more carefully examines the process of “learning” through members’ causal beliefs, the relation of L11, in the next section.

Considering the L12 and the L13 relation, we pay attention to “core technology,” which Thompson (1967) said is the key factor for organizational continuation and growth due to the causal beliefs embodied in it. This model describes organizations as having an ambivalent existence and elaborates on the causation between an organization and its external environment. However, the model does not include treatment cultural values; for instance, “How does core technology appear through value?” Therefore, to clarify the causation of organizational “learning,” we examine the value which might be contributed by the societal and natural environments.

Causal beliefs and the basis of learning

In the latter stage of contingency theory development, researchers realized that organizations react to the recognized environment (Duncan, 1972; Downey & Slocum, 1975). An organization was regarded as not only being affected by the environment but also dissecting the external environment in relation to organizational strategy (Child, 1972; Duncan, 1973). This epistemological, organizational perspective connected with the Michigan school’s interpretivism approach to emphasize the subjectivity of organizations (e.g., Weick, 1969, 1979; Morgan, 1989), which was based on the subjective dimension of regulation sociology (Burrell & Morgan, 1979). In examining causal beliefs as a basis of learning, this study reviews the relevant discussion in the literature.

Weick (1969, 28) proposed the idea of an “enacted environment.” While he postulated that future planning and action are carried out not in the vague future perfect tense but in the past perfect tense, he stated that “an action accomplishes in enacted environment according to the organizational concern or the range of cautions.” Moreover, Morgan (1989, 91) indicated that the meaning of “environment” is not a given, but is made by organizations. He showed that the external environment would be created by organizations to draw some kind of “imaginary line” (Morgan, 1989, 93) among the elements that are scattered in the external environment, and as a result the objective world would assume a different meaning for each organization.

Also, the sociologist, Yoshida (1991, 26–27), following the functionalism approach, stressed the need to discern the external environment in the ontological dimension. According to his study, a subject in the real world is affected only through the cognitive world, who should recognize that the external environment exists only in its meaning to a subject. Also, he insisted that a subject is valid in the “private universe,” which is selected and is cut off by self-concern from the cognitive world (Yoshida, 1991). Information repeats such cycles as in this circular argument: “a subject ⇒ its cognitive world ⇒ objective world ⇒ its cognitive world ⇒ a subject.” If organizational members create a collective cognitive environment (or enacted environment) by perceiving and learning the objective world, the collective cognitive environment will be indispensable to organizational members’ actions. Then, we should note that any result is dependent on the state of the “cognitive map” at the time of learning from the objective world.

Cognitive map was defined by Tolman (1948) as human knowledge by editing through the organizational experience, which is a particular way of representing complex systems as a person’s assertion about some limited domain, such as a policy problem (Axelrod, 1976). Also, the cognitive map has been applied to investigate collective actions and organizational decision-making (Bougon, Weick, & Binkhorst, 1977). It consisted of the concept and the ability to understand organizational situation by participants (Weick, 2001). When members’ cognitive maps partially overlap, those produce “collective causal beliefs and provide a basis for simultaneous unity and diversity in organizational process” (Axelrod, 1976; Fiol & Huff, 1992). Then, we emphasize, if the collective causal belief cannot reflect the present, objective world precisely, the organization will suffer severe setbacks. Given the above discussion, this study focuses attention on the emergent process of “collective causal beliefs” as one foundation of innovative green technology. Through the following discourses, the study investigates what kinds of collective causal beliefs are observed in realities.

3. METHODOLOGY

Interview methods are mainly divided into the directive method and the nondirective method. This study employed the latter; therefore, we could clarify and explore specific aspects of the events in question. However, the nondirective method has some disadvantages. For instance, the content of the interview questions tends to follow a stereotype, and the results can be affected by the skills of the interviewer. In order to ensure the reliability of the interview method and the validity of the results, Yin (1994) emphasized the importance of (a) maintaining the chain of evidence, (b) creating a case study database, and (c) using multiple sources of evidences. This study was conducted based on these three principles to avoid possible detriments caused by the nondirective method. We created an interview database and expressly confirmed the facts with every subject by e-
mail and telephone to secure reliability in the chain of evidence.

Further, for the interviews, we searched for and extracted samples where public companies developed new environmental conservation businesses in Japan. When listed companies develop environmental conservation businesses for diversification, there are two kinds of patterns: (a) establishing an environmental conservation business within a company as another business, and (b) establishing an environmental conservation business as a subsidiary. We chose samples to cover both patterns. Taisei Corporation is an example of the former, and Tokyo Eco Recycle Co., Ltd. is an example of the latter. In the interviews, we mainly focused on the following three questions: (a) what kind of core technology is employed for the environmental conservation business; (b) how the core technology is developed; and (c) what kinds of collective causal beliefs lie hidden beneath the developing process of the core technology.

4. DISCOURSES OF FIRMS

The business description of Taisei Corporation is building construction, civil engineering, and real estate development. The Japanese company was founded in 1873 and employs 7,951 people. Conversely, the business description of Tokyo Eco Recycle Co., Ltd. is the recycling of discarded home appliances. The company employs 110 persons and it was founded in 1999 as a subsidiary of Hitachi Ltd. which is a Japanese publicly listed electronics manufacturer. Table 1 shows the capital, profiles, net sales, and core technology of the companies.

INNOVATIVE ECOLOGICAL DISMANTLING SYSTEM

Generally, the dismantling of high-rise buildings is performed using several cranes. At construction sites, dust rises, and the loud noise is constant, which causes anxiety for passers-by in the neighborhood. Also, bad weather can hinder the dismantling work. Taisei Corporation, a construction company from Tokyo, has developed a system for dismantling high-rise buildings that isolates the buildings from the outside by covering it with a concealing shield, like putting on a hat. The concealing shield functions as soundproofing and prevents the scattering of dust. The high-rise building can be quietly dismantled as though it has sunken into the ground, and the work is not affected by the weather. The construction of a new building can be carried out on adjoining land as the dismantling does not affect the neighborhood at all.

First, Taisei Corporation dismantled the old Otemachi Financial Center (Tokyo, Japan) from February 2011 to July 2012 using this system. The building had twenty-four stories above ground, four stories below ground, and stood at a height of 105 meters. First, the top of the building was covered with a concealing shield, utilizing the roof of the building to be dismantled. The dismantling was performed beginning with the upper part of the building. Next, the company started to dismantle the old Grand Prince Hotel Akasaka (Tokyo, Japan) in May 2013. This building was thirty-nine stories above ground, two stories below ground, and was a height of 139 meters. This project used the same process as the old Otemachi Financial Center and was completed in ten months.

As the floor and walls of one floor are dismantled, fifteen oil-pressure jacks supporting the ceiling are lowered and the dismantling of the floor below begins. For the internal demolition work, a hole is opened in the same place on all floors to lower waste materials to a truck waiting on the first floor. When the crane lowers waste materials to the first floor, the regeneration brake generates electricity to bring up the crane and illuminate the inside of building. Therefore, the use of new energy is not needed. The development leader at Taisei Corporation said the following.

“In the process of technological development, an emergent team was formed by off-duty engineers. Because the theme was enjoyable, engineers held voluntary meetings every week, and discussed imaginative ideas with playfulness. Both the owner and the neighborhood are anxious about dismantling the building, which is more than 100 meters high. Thus, we need to dismantle it silently and safely. We do not want to show passers-by the inside of the demolished building because its dismantled appearance is ‘mittomonai’ (meaning ‘disgusting’). Almost all members thought that avoidance of mittomonai must be the concept of our project. Further, someone asked ‘How it can be avoided?’ and somebody said, ‘Why don’t you cover the building with something like a balloon?’ As we repeated such arguments with proper comparison of economic efficiency, for example utilizing the roofs of high-rise buildings, we created a new closed-type dismantling technology. Our dismantling method consists of more than 300 elemental technologies combined for synergy. The cost is slightly higher than a normal dismantling method, but the cost becomes approximately equal when the height of the building is over 200 meters.”

Other Japanese manifold construction companies have followed Taisei Corporation, with similar environmentally-conscious dismantling technologies competing with each other in the past few years.

Advanced recycling by manual labor

Conversely, Tokyo Eco Recycle Co., Ltd. (Tokyo, Japan) is engaged in extracting recyclable materials from discarded home electric appliances, for instance air conditioners, televisions, refrigerators, freezers, and washing machines. The discarded home electric appliances are efficiently dismantled by manual labor to separate and recover their plastic and metal components. The separated materials are then crushed and sorted by special machines. The maximum processing capacity of the company is 0.6 million units and it has demolished approximately 0.3 million units in a year.
The recycling rate has been kept over 99.9% in the company, something which has never seen in other recycling companies. Tokyo Eco Recycle Co., Ltd. has several manual labor lines in the plant, and each line has an electric signboard that displays two numbers. The president of Tokyo Eco Recycle Co., Ltd. said the following.\(^{(3)}\)

The daily goal for scrap appears on the upper section of the electric signboard. This daily goal is created by the workers so they can voluntarily manage their work. The number in the lower section of the electric signboard shows the total amount of discarded appliances processed in a day. The workers say, ‘We will challenge ourselves to set a new record for the processing number today,’ and, ‘We can achieve our goal if we process another 130 in the afternoon.’ They feel a daily sense of accomplishment and create a climate of competition.\(^{(4)}\) I think that our employees are ‘modern craftsmen.’ For instance, a worker explained the characteristic structure of the refrigerator of a Hitachi 1992 model and he devised a dismantling method while having fun. It must be hard work, but the current recycling never advances without a hands-on process. In particular, the professional manual operation workers feel they are contributing to stem the drain on useful resources, as there are few natural resources in Japan. When there is something from which materials cannot be extracted, almost every worker feels mottainai (meaning it is ‘wasteful’). There should not be anything from which materials cannot be extracted. They understand that their expert skills and wisdom are needed. It cannot all be done by machine. However, we were troubled by the number of steps of manual labor required to balance economic efficiency and environmental protection after the establishment of our business during the past one-and-a-half years. Finally, we set twelve steps of manual labor on air conditioners and washing machines, seventeen steps on televisions, and ten steps on refrigerators. We have performed the hands-on process on discarded home electric appliances in around 8–14 minutes per unit.

As Tokyo Eco Recycle Co., Ltd. has improved the complicated hands-on process continuously, the total amount of discarded appliances processed by April 2016 exceeded six million. A lot of people, including visitors of other recycling companies’ engineers, visit the factory tour course every year.

5. DISCUSSION

Although the present research was limited to a small sample of two companies, we believe the results have indicated several strong tendencies. As mentioned, we focus on three questionnaire items and give further analyses below to clarify the emerging process of innovative green technologies. To explore the answers of the following questions, we mainly examine the L12, L13 and the L21, L31 relationships. The former indicates organizational “planning” through innovative green technologies, and the latter shows the collective causal belief of an organization that is affected and reconstructed, namely “learning” through the environmental effect.

(a) What kind of core technology environmental conservation business was adopted?

(b) How was the core technology developed?

Taisei Corporation developed a dismantling system for high-rise buildings to isolate the buildings from the outside. The system consists of more than 300 elemental technologies, for example, oil-pressure jacks for supporting the ceiling, and regeneration brakes for generating electricity. For Tokyo Eco Recycle Co., Ltd., a skilled, hands-on dismantling process plays a central role for technologies. As a whole, the process becomes an assembly line as a nucleus in these technologies. Thus, we suggest that the two companies hired core technology of the “long-linked technology” type proposed by Thompson (1967). It is important to note that the two companies tried to balance economic efficiency and environmental protection in developing their core technologies. For Taisei Corporation, the knowledge of covering a high-rise building with something like a balloon was efficiently embodied in the method of utilizing the roofs of high-rise buildings for the concealing shield. On the one hand, if Tokyo Eco Recycle Co., Ltd. were to dismantle all parts of discarded home electric appliances by manual labor, they could reduce their environmental footprint significantly. However, their dismantling productivity would also decrease significantly. Therefore, they learned the number of steps of manual labor required to attain a balance between economic efficiency and environmental protection. In the amended causal texture, we indicate that the two companies recognized not only the correlation of L12 and L21 but also the correlation of L13 and L31 in their businesses.

(c) What kinds of collective causal beliefs lie hidden beneath the developing process of the core technology?

For Taisei Corporation, engineers thought that the buildings should be demolished silently and safely so people would not be anxious about their dismantling. Also, for Tokyo Eco Recycle Co., Ltd., workers thought that their recycling work was contributing to stem the drain on useful resources by the social order. In the creation of the technologies, we speculate that the collective causal belief was to relieve people’s anxiety regarding danger or the draining of resources. How can we interpret the meaning of the collective causal belief?

At first, we look for clues in existing studies of legitimation, because legitimacy is the basis of the social power of modern, public companies. Berger and Luckman (1966, 92) emphasized the importance of legitimacy in the social construction of explanations and justifications for actors’ existence. Showing that legitimation is derived from
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Max Weber, they pointed out that the function of legitimacy is to make the “first-order objectivations” that have been institutionalized objectively available and subjectively plausible. The two companies proactively adjust their businesses to the recycling regulations that have been established in Japan,(5) and, as a result, contribute to reinforcing the “first-order” governmental institutions and justify their own environmental conservation businesses in society. Further, Suchman (1995, 574) defined legitimacy as a generalized assumption where the actions of an entity are desirable within some socially constructed system of norms and values. Berger and Luckman (1966, 93) also emphasized that legitimization has a cognitive element as well as a normative element. This discussion means that legitimacy is acquired not only adjusting environmental regulations, but also considering people’s notions as the sense of societal environment. As mentioned above, the two companies proactively adjusted to the former, but the latter could be especially observed in the two discourses.

So, to summarize, the following assumption can be deduced (see Figure 5). The acquisition of social legitimacy has two effective dimensions. The first is by adjusting environmental regulations, and the second is by considering people’s notions. In particular, we found through our interview that the latter was learned among workers from causal beliefs about the value of reducing people’s anxiety.

Now, we should examine whether the element of social legitimacy only affected the collective causal belief. It is rash to conclude that legitimacy is the only source for green technologies. We can find another important trait in the discourses.

In Taisei Corporation, engineers expressed another belief; they did not want to show passers-by the inside of the demolished building, because its dismantled appearance was mittomonai. Also, in Tokyo Eco Recycle Co., Ltd., workers believed there should not be anything from which materials could not be extracted; the workers felt mottainai. Briefly, mittomonai means disgraceful or shameful, and mottainai, also a Japanese adjective, means something is wasteful or worthy of a better cause. The etymology of mittomonai dates back to the Middle Ages in Japan, when it meant “do not want to see,” but now it is used to mean the avoidance of poor appearance. Mottainai is a Buddhist term, meaning, originally, the sense of repentance for the disappearance of an existing figure, but now we use it to mean an avoidance of a wasteful action. Following this, we speculate that “avoidance of undesirable actions” in society is common in the terms mittomonai and mottainai. In Taisei Corporation, the term mittomonai as the Japanese cultural value was embedded in the collective causal belief of the engineers, and they were able to create the innovative green technology to isolate the building from the outside. Also, at Tokyo Eco Recycle Co., Ltd., the high recycling rate was achieved, because the Japanese cultural value of mottainai permeates the collective causal belief.

Uniting the above arguments, it is reasonable to assume that the traditional Japanese cultural value of the “avoidance of undesirable actions” affected the collective causal beliefs in developing innovative green core technologies in the two companies. To summarize, our research yields the following assumption (shown in Figure 6). There are two trends from “learning” to “planning” in the source of innovative green technologies. The first trend of “learning” is that awe towards nature is a trigger for tightening green regulations and changing economic activities of firms (L32, L31). Furthermore, the effects of the societal environment (L21), the acquisition of social legitimacy, and prompting relief of people’s anxiety are shared in the collective causal belief of organizations (L11). Consequently, innovative green technologies as organizational action can be described as “planning” and can influence the societal and natural environments (L12 and L13). This shows the interdependence between L32 ⇒ L21 ⇒ L11 ⇒ L12 and L13.

The second trend of ‘learning’ is that the Japanese cultural value of “avoidance of undesirable actions” is embedded in the organizations (L21) and shared among workers as collective causal beliefs (L11). As a result, the “planning” of innovative green technologies emerged and affected the societal and natural environments (L12 and L13). This trend indicates the interdependence between L21 ⇒ L11 ⇒ L12 and L13.

6. CONCLUSIONS

This paper discussed the process of developing innovative green technologies based on discourses from Taisei Corporation and Tokyo Eco Recycle Co., Ltd. The study addressed the following research questions: 1) how does innovative green technology emerge in firms? and 2) what types of cultural factors affect the process? The study examined these questions using a revised causal texture model, which clarified the interdependence among organizations, the societal environment, and the natural environment and focused on the emerging process of collective causal beliefs in the development of green core technologies. The study derived two major findings.

First, a common factor between the two core technologies considered in this study, namely, a dismantling system for high-rise buildings to isolate the buildings from the outside (Taisei Corporation) and a skilled hands-on dismantling process (Tokyo Eco Recycle Co., Ltd.), balanced environmental protection with economic efficiency using innovative ideas and experiments. Furthermore, both examples hired the “long-linked technology” type of core technology, proposed by Thompson (1967). For Taisei Corporation, the knowledge of covering a high-rise building with something like a balloon was efficiently embodied in the method of utilizing the roofs of high-rise buildings for the concealing shield. By contrast, Tokyo Eco Recycle Co., Ltd. specified the number of steps of manual labor, which minimizes the amount of waste generated while maximizing economic efficiency across the dismantling line. Following the amended causal texture model, we point out that the innovative green technologies would emerge not only as
“planning” in the correlation of L12 and L13, but also as “learning” in the correlation of L21 and L31. We demonstrate that it was nothing less than a process of trial and error involving “planning” and “learning.”

Second, we clarified what types of elements lie hidden behind organizations’ collective causal beliefs in the process of developing the innovative green technologies. It was an issue of “learning” in the correlation of L21, and there were two factors: 1) to acquire social legitimacy, organizations tried to adjust environmental regulations and consider people’s desire to release other people’s anxiety, and 2) the traditional Japanese cultural value of mittomonai and mottainai affected the collective causal beliefs in organizations. Among them, we emphasize that the latter became a significant idea source of green innovative technologies, because the Japanese traditional cultural value of mittomonai and mottainai, which could be unified in the value of “avoidance of undesirable actions,” are embedded in the collective causal beliefs of members.

However, there remain some issues in this paper. First, the present study was limited to only two companies, which is not a sufficient sample to draw conclusions regarding the value of the amended causal texture model for examining innovative green technologies. Second, we based the results on the individual perceptions of executives; therefore, the study reflected only a part of the organizational process. Finally, the sample used in this study is limited to recycling businesses, and further research should examine whether the findings hold in other areas such as global-warming mitigation measures.

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NOTES

(1) According to Thompson’s model, for organizations to utilize maximum rationality, “core technology” should be employed and displayed as a system that changes inputs into outputs. Thompson (1967) stressed three main types of core technology: (a) long-linked technology, as seen in manufacturing enterprises’ mass production assembly lines; (b) mediating technology, characteristic of banks or advertising agencies; and (c) intensive technology, seen in general hospitals or consulting firms (Thompson, 1967, 15–18). The key to the continuation and growth of an organization is in how to reduce uncertainty. To accomplish this, the organization must maintain flexibility toward the environment, while ensuring certainty within itself.

(2) We conducted the interviews with the development leader at Taisei Corporation in April 2013 and May 2014.

(3) We conducted the interviews with the presidents at Tokyo Eco Recycle Co., Ltd in August 2003, March 2009, and May 2014.

(4) To provide an additional explanation, when we speak of the recycling business, we are apt to imagine the working environment as hard and grim, but the engineers and workers work with a spirit of playfulness. If we borrow the ideas of Morgan (1989), we could interpret the notion of a playful mind in the recycling business as a means of “self-defense” or “self-esteem” to repel the depressing atmosphere of the work environment.

(5) For example, the law concerning the recycling of household appliances was put into effect in April 2001. This law requires consumers to pay recycling fees for four kinds of electric household appliances, which seeks to reduce waste and effectively use resources.

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