Application of Causation and Effectuation Processes to Risk Management

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Abstract

This study focuses on the necessity of making a distinction between two types of uncertainties -measurable and unmeasurable- in risk management. Then, it proposes a new framework for the application of Sarasvathy's (2001) effectuation and causation processes to non-quantifiable and quantifiable risks, respectively.

Keywords: Risk Management; Uncertainty; Effectuation; Causation; Decision-Making

1. Introduction

In my previous research (Uehara, 2002), which was focused on risk evaluation under uncertainty, I mentioned problems in the quantification of risks and pointed out the necessity of distinguishing risks with an extremely low frequency of occurrence, to which the law of large numbers does not apply, from those to which it is applicable.

In risk management, the enterprise risk management (ERM) framework of the Committee of Sponsoring Organization of the Treadway Commission (COSO) in the US has become a global de-facto standard. In 2017, COSO published "Enterprise Risk Management―Integrating with Strategy and Performance" (COSO, 2017) as the revised version of the ERM Framework of 2004, for entities to deal with the uncertainties that derive from risk diversification and the pursuit of new business opportunities in modern times. The focus of COSO's ERM is the "risks involved in strategic decision-making processes associated with business opportunities," through which it emphasizes the importance of identifying new, emerging, and changing risks in risk recognition.

Meanwhile, entities are constantly seeking new business opportunities and conducting internal corporate venturing to advance into new business areas and to continue to grow in today's highly competitive environment. As a result, every entity faces several types of risks that accompany new opportunities and must take uncertainties into account when

recognizing risks. Sarasvathy (2001) proposed the concept of "effectuation", an entrepreneurial decision-making process to deal with such uncertainties, as a cognitive inverse of the term "causation".

This study focuses on the necessity of recognizing two types of uncertainties―measurable and unmeasurable―in today's rapidly changing and uncertain business environment, in which risk management has become even more important. Then, it proposes the "Application Framework of Effectuation and Causation to Quantifiable and Non-Quantifiable Risks", through which Sarasvathy's (2001) effectuation and causation processes are respectively applied to risks that are extremely difficult to quantify, in "Zone 1", and risks that can be quantified, in "Zone 2" of the "Occurrence Frequency-Based Risk Management" (Uehara, 2002).

2. Theoretical background

2.1 Presence of uncertainties in risk recognition

In this world of rapid globalization and informatization, not only companies but every business entity needs a strong structure to deal with uncertainties and risks that come along with the pursuit of new business opportunities. It is of vital importance to avoid such risks in the execution of daily work while seizing new opportunities and developing and implementing new strategies.

Moreover, as pointed out by Beck (1986), as modernization progresses, humankind produces, alongside the production of wealth, completely new types of danger (risks) that have never been experienced before. In the last few years, there have been many man-made accidents involving nuclear power plants and disasters such as never-before-registered heavy rains attributed to climate change. For such unprecedented and extremely rare events that occur once in hundreds of years, there are no mathematical or statistical probabilities, and quantitative measurement or assessment of the risks of such cases faces a difficult problem of extreme uncertainty.

Knight (1921) distinguished the measurable uncertainty and an unmeasurable one and used the term "risk" to designate the former and the term "uncertainty" for the latter, and developed a theory based on the differences between the two. Unlike the former, with the latter, it is impossible to identify or classify a situation based on which the probability is formed. He also developed a logic, known as "Knight's theory," that states if the situation on which the estimation is based is an extremely rare and singular event, "the law of large numbers" is not applicable. Furthermore, if a frequency-based mathematical or statistical

probability based on the law of large numbers does not exist for that event, it is a "true uncertainty" that cannot be measured.

2.2 Enterprise Risk Management (ERM)

ERM is gaining importance as a risk management approach for organizations to deal with the requirements of the ever-changing business environment.

In 2004, COSO published "Enterprise Risk Management—Integrated Framework" as a guideline for corporations to manage changes in the business environment. Then, in 2017, it published "Enterprise Risk Management—Integrating with Strategy and Performance" (COSO, 2017) for any entity ("Entity" is a broad term that can encompass a wide variety of legal structures including for-profit, not-for-profit, and governmental entities.) to deal with uncertainties derived from risk diversification and the pursuit of new business opportunities in modern times as the revised version of the ERM Framework of 2004.

COSO's ERM is based on the premise that, in risk management, it is necessary to identify and deal with the uncertainty of "potential events," which are considered risks that may impact business organizations.

Also, in 1992, COSO published the Internal Control—Integrated Framework, which was expanded and turned into the ERM—Integrated Framework of 2004. Moreover, since a long time has passed since 1992 version of the Internal Control publication, COSO reviewed its framework to adapt it to the present complex business environment and published its revised version in 2013.

Regarding the relationship between COSO's Internal Control and ERM, the former is considered the base of the latter. In COSO's view, there is no superiority or inferiority between ERM and Internal Control; rather, both are separate elements that complement each other. Further, according to DeLoach & Thomson (2014), while COSO's ERM framework applies to risks involved in strategic decision-making processes associated with business opportunities, COSO's Internal Control—Integrated Framework is applicable to the risks involved in the execution of business activities specified in the strategy setting. In other words, they classify the risks faced by entities into "risks involved in strategic decision-making processes associated with business opportunities" (risks associated with business opportunities) and "risks involved in the execution of business activities specified in the strategy-setting" (risks associated with the execution of business activities).

Also, in "Principle 10: Identifies Risk" of COSO's ERM, there is a segment that states, "The organization identifies risk that impacts the performance of strategy and business objectives." (COSO, 2017, p. 67). Regarding the identification of risks, it says, "the

organization identifies new, emerging, and changing risks to the achievement of the entity's strategy and business objectives" (COSO, 2017, p. 67). It also cites previously unknown risks that had never been experienced as examples of new, emerging, and changing risks.

Based on the above, COSO's ERM requests the following:

- That the organizations be able to deal with two types of risks: (a) "Risks involved in strategic decision-making processes associated with business opportunities" (risks associated with business opportunities) and (b) "risks involved in the execution of business activities specified in the strategy-setting" (risks associated with the execution of business activities).
- That organizations identify new, emerging, and changing risks involved in their strategy and pursuit of business goals.

As more companies perform internal corporate venturing to advance into new business areas and secure growth and profitability, incorporating new opportunities into risk management is becoming crucial. For this reason, the revised version ERM of 2017 suggests that it is useful to incorporate risks into the decisions involved in the development of strategies and daily work, and that it is efficient to define the risks that the organization is willing to take to achieve the desired performance and meet business strategies and goals (that is, its risk appetite).

2.3 The necessity of occurrence frequency-based risk management

This section highlights the importance of occurrence frequency-based risk management when evaluating risks under uncertainty and outlines my previous research that focused on the problems involved in the recognition of potential events with unmeasurable uncertainties and how to deal with them (Uehara, 2002).

2.3.1 The necessity of occurrence frequency-based risk management in risk evaluation

Previously, I focused on the difficulty of assessing risks under uncertainty and understanding tail risks and pointed out that, in risk management, risks could be distinguished between those to which the law of large numbers applies and those to which it does not (Uehara, 2002). Then, both kinds of risks were examined using Knight's (1921) concept of uncertainties that can be measured with probability and those that cannot ("true" uncertainties).

When recognizing risks, entities must be aware of the presence of tail risks, which relate to the occurrence of extremely rare events that they have not experienced themselves but

generate enormous losses if they occur. Measuring or estimating such risks quantitatively is extremely difficult.

There are attempts to solve the problem of tail risks in risk management by using Extreme Value Theory (EVT) in addition to the application of the conventional risk quantification theory. A common characteristic of loss data for risk evaluation is that in many cases, the number of samples is small but the losses (and their impact) are huge. For events with a large number of samples, there are several measurement and estimation methods that can calculate the severity of a risk using fine statistical properties and considering their likelihood of occurrence and impact. However, not many methods can adequately estimate the severity of events with a small number of samples or exceptionally rare events with a "super" small number of samples. Even with the EVT method above, it is considered highly difficult to create a model that fits the entire distribution, because when the tail part fits, the remaining part does not.

Even if the tail part is quantified with the method above, the tail risk is located far outside the confidence interval (for example, 99 percentile value), as shown in Fig. 1. Therefore, in order to cover this risk, it is necessary to widen the confidence interval considerably. However, considering the capital and insurance required and the cost of financial risks involved, widening the confidence interval to prepare for a tail risk is a difficult decision for a business administrator to make.

On the other hand, data of operational mistakes with low financial impact and high frequency can be easily gathered and quantified with statistical methods, but this type of risk hardly puts companies in risky situations. This is a common occurrence that is processed as a loss in the annual expenses.

Also, as mentioned in Section 2. 1, Knight (1921) classified uncertainties between those that can be measured with probability (using the term "risk") and others that cannot, that is "true uncertainties".

Considering the above, entities must make a clear distinction between the risks with unmeasurable uncertainty, to which the law of large numbers does not apply (Zone 1 of Fig. 1), and the risks with measurable and quantifiable uncertainty (Zone 2 of Fig. 1) and manage them accordingly.

In a very unfortunate manner, the necessity that I proposed of managing risks according to their frequency of occurrence was proved by the events that followed the Great East Japan Earthquake on March 11, 2011. That is, it is said that risks must be evaluated according to the measurement of their impact and likelihood of occurrence, but it is difficult to identify risks with unmeasurable "true" uncertainty and unknown probability in the same manner that risks with measurable uncertainty are identified. Due to the difficulty of

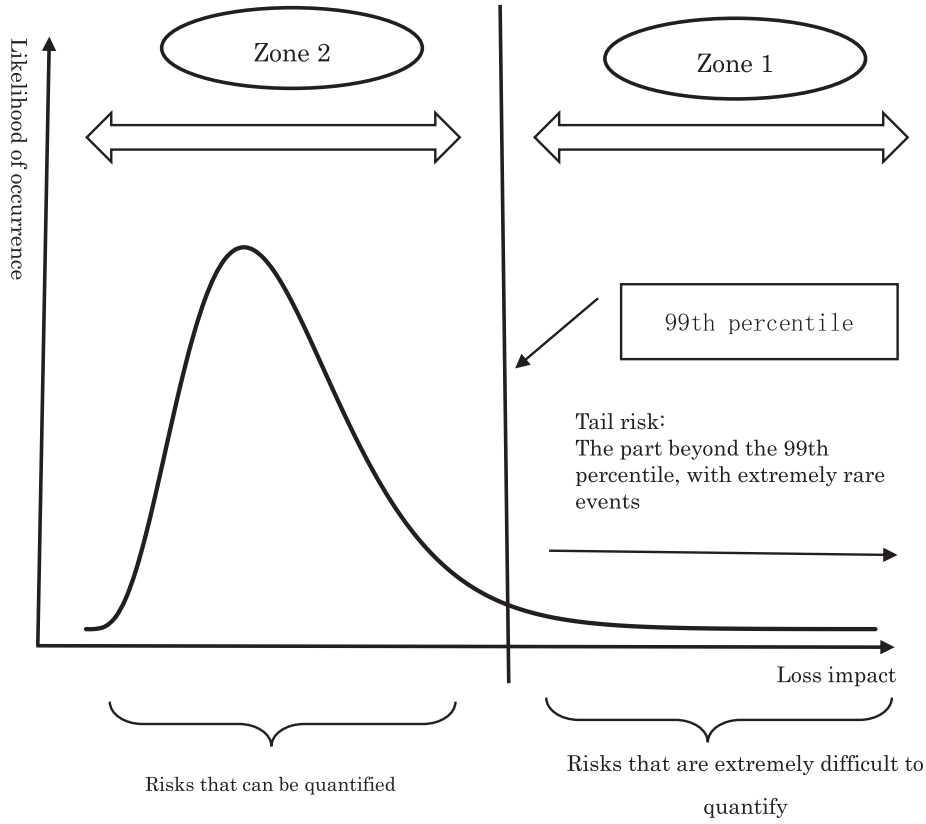

Fig. 1 — “Zone 1”, where the risks that are extremely difficult to quantify, and “Zone 2”, where the risks are quantifiable

identifying the potential risks associated with the earthquake, tsunami, and nuclear power plant accidents that followed, it was not possible to respond to those events appropriately. In the end, the necessity of managing risks according to their frequency of occurrence that I previously pointed out, based on the applicability of the law of large numbers, was demonstrated in practice.

2.3.2 Problems in the identification of potential events with unmeasurable “true” uncertainties

The Great East Japan Earthquake also exposed problems in the identification of potential events, more specifically, when it is impossible to identify or classify a situation based on which the probability is formed and the unmeasurable “true” uncertainty is so rare and singular that the law of large numbers does not apply. That is, even though many entities have built risk management systems based on COSO’s ERM and identify potential events with uncertainty, some cases suggest that certain decisions made during the identification

of potential events with such an extraordinary and singular uncertainty like this earthquake were conflicting; they could be considered both "unimaginable" and "worth considering."

In other words, in situations like the above (to which the law of large numbers does not apply), the identification of potential events in risk management was carried out with conflicting decision-making. This is a problem of humans making decisions under uncertainties that can be attributed to both the presence of measurable uncertainties, which can be calculated with transcendental or statistical probability, and unmeasurable uncertainties with unknown probabilities and almost no precedent, as proposed by Knight (1921).

Once again, these events stressed the necessity of distinguishing risks with measurable uncertainty from risks with unmeasurable "true" uncertainty and managing them according to the respective frequency of occurrence, which I pointed out in my previous research.

2.4 Causation and effectuation in entrepreneurship

2.4.1 Risk in entrepreneurship

The concept of risk has always been centered on entrepreneurship since Knight (1921). He pointed out the importance of making a clear distinction between the three types of probability situations.

The first type is the "a priori probability." For example, the probability of rolling a dice and getting a one is one in six; the probability of getting an odd number (that is, 1, 3, or 5) is one in two.

The second type is statistical probability. This is an empirically determined number, such as the average life expectancy of men and women, traffic accident mortality, or the probability of rainfall in a particular country.

The problem is the third type, the probability situation, which Knight calls estimates. While the two other types are related to risks, the third is related to "true" uncertainties. The difference between these is decisive. Regarding the third type, Knight (1921) says, "The distinction here is that there is no valid basis of any kind of classifying instances." (Knight, 1921, p. 225).

For this reason, Sarasvathy (2008) focused on how a expert entrepreneur who is about to start a new business makes decisions when they encounter a future that corresponds to this third type of "Knightian uncertainty." Then, as an attempt to create a theory that opposed the Knightian uncertainty, she coined the concept of "effectuation," which is the opposite of "causation."

2.4.2　Entrepreneurial action in the face of uncertainty

Entrepreneurs can choose many different strategies to cope with the uncertainties associated with the creation of new venture companies. To address this central research problem in entrepreneurship, Sarasvathy (2001) proposed the concept of effectuation as a dominant decision model for entrepreneurial decision-making that is especially well suited when there is no existing market.

Sarasvathy (2008) explains "effectuation" as below:

> Effectuation is the inverse of causation. Causal models begin with an effect to be created. They seek either to select between means to achieve those effects or to create new means to achieve preselected ends. Effectual models, in contrast, begin with given means and seek to create new ends using non-predictive strategies. In addition to altering conventional relationships between means and ends and between prediction and control, effectuation rearranges many other traditional relationships such as those between organism and environment, parts and whole, subjective and objective, individual and social, and so on. In particular, it makes these relationships a matter of *design* rather than one of *decision*.
>
> *Empirically*, entrepreneurs use both causal and effectual approaches, in a variety of combinations. Use of and preference for particular modes is related to the entrepreneur's level of expertise and where the firm is in its life cycle. *Theoretically*, however, it makes senses to analyze causal and effectual approaches as a strict dichotomy. (Sarasvathy, 2008, p. 16)

Sarasvathy (2008) represents the two approaches above as shown in Fig. 2. In this diagram, the process of effectuation is shown as an opposing concept of "Segmentation-Targeting-Positioning" (STP), which is currently adopted by most marketing textbooks. Clearly, effectuation and causation face opposite directions.

Meanwhile, Dew et al. (2005) conducted a comparative analysis with 27 seasoned entrepreneurs (experts) and 37 inexperienced entrepreneurs (novices). The results revealed that 89% of the first group preferred the logic of effectuation over causation, and 81% of the second group used the approach of causation instead of effectuation.

Also, Welter and Kim (2018) conducted agent-based simulation using the NK model (Kauffman, 1993; Levinthal, 1997) to test the theoretical difference between the approaches of causation and effectuation. This simulation indicated that, in many cases, the venture's performance was better when effectuation was used. Also, for the venture performance when causation was used, the entrepreneurs were able to predict the correct result with

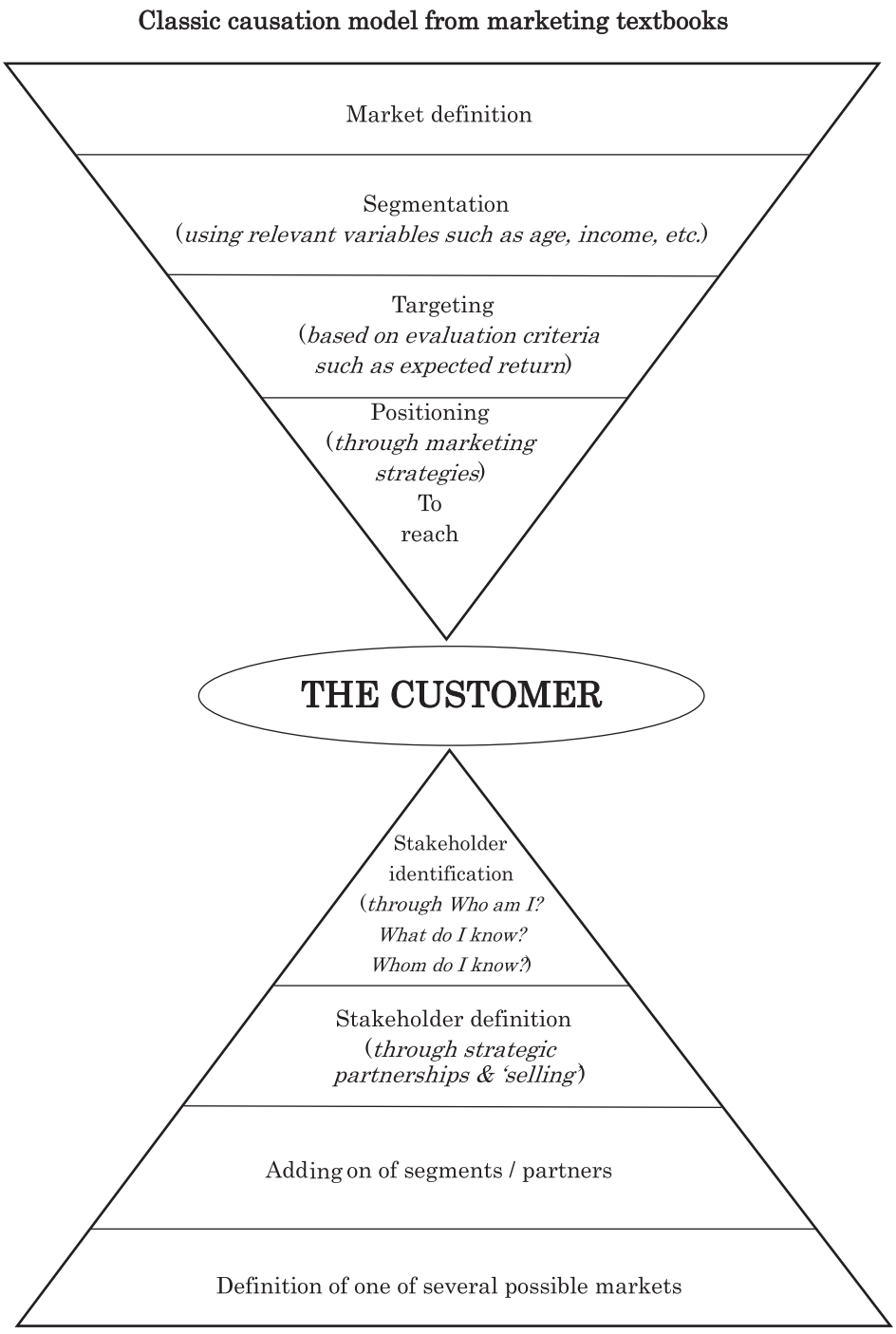

Fig. 2 — Contrasting the textbook (causal) model of marketing with effectuation (Sarasvathy, 2008, p. 39, Fig. 2.1)

very high accuracy (way above 50%). Moreover, both in risky and uncertain situations, the venture performance with effectuation was higher than with causation; for causation to perform better than effectuation, the prediction capability had to be very high (a minimum accuracy of 75%). When detailed planning was made with causation, it did deliver fine results, but only if the entrepreneur could define the prediction very accurately (greater than 75%). From these results, it is possible to assume that the threshold to use causation or effectuation is whether the prediction accuracy is 75% or higher.

3. Presentation of conceptual framework

As mentioned in Section 2.2, in connection with risks faced by entities, COSO's ERM emphasizes the "risks involved in strategic decision-making processes associated with business opportunities" (risks associated with business opportunities) and urges that "the organization identifies new, emerging, and changing risks to the achievement of the entity's strategy and business objectives."

However, in today's environment of rapid globalization and informatization and intense competition, entities are advancing into new business areas to ensure growth and profitability. They are also constantly conducting internal corporate venturing according to strategic decision-making processes associated with new business opportunities. This context makes it indispensable that risk management be responsive to new opportunities, but that creates a dilemma because the "true" uncertainties involved in new opportunities pointed out by Knight make it more difficult to recognize potential risks.

In Section 2.3.1, I examined the recognition of risks from the perspective of Knight's (1921) concept of uncertainties that can be measured by probability and "true" uncertainties that cannot and emphasized the importance of implementing risk management that distinguishes these two elements.

As mentioned above, COSO's ERM stresses the "risks involved in strategic decision-making processes associated with business opportunities" (risks associated with business opportunities) and urges that "the organization identifies new, emerging, and changing risks to the achievement of the entity's strategy and business objectives."

Also, in connection with the actions of entrepreneurs that face the risks and uncertainties of entrepreneurship, Sarasvathy (2001, 2008) presented the theory of effectuation, which is designed to deal with the "Knightian uncertainties" mentioned in Section 2.4.

In this study, Sarasvathy's (2001, 2008) approach of causation and effectuation is applied to my concept of "Occurrence Frequency - Based Risk Management in Risk Evaluation" to expand its framework. That is, I propose a new "application framework of effectuation and

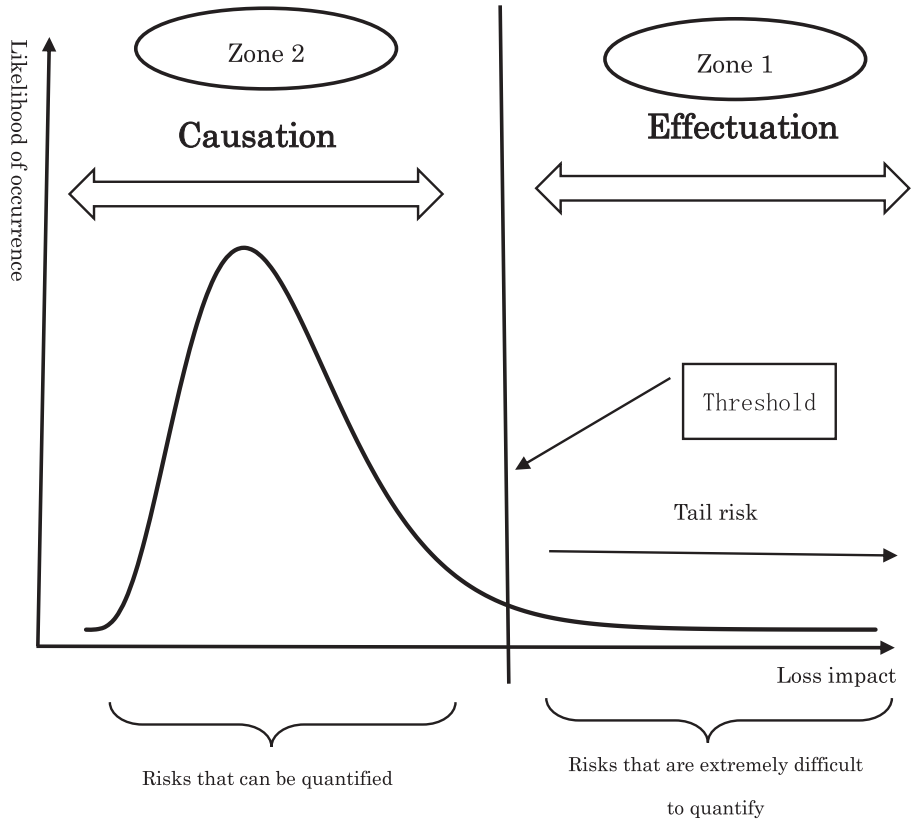

Fig. 3 — Application framework of effectuation and causation to quantifiable and non-quantifiable risks

causation to quantifiable and non-quantifiable risks," which, as illustrated in Fig. 3, applies the effectuation to the risks of "Zone 1" as in Fig. 1, which are extremely difficult to quantify, and the causation process to the risks of "Zone 2," which can be quantified.

In the first step of this framework, the entities must distinguish the risks between those of Zone 1 and those of Zone 2, based on the respective "threshold" for risk recognition. After this separation, it must recognize the risks of "Zone 1" using the process of effectuation and the risks of "Zone 2" using the process of causation.

4. Conclusion

As specified in COSO's ERM, in modern risk management, it is essential that entities be able deal with two types of risks—"risks involved in strategic decision-making processes associated with business opportunities" (risks associated with business opportunities) and "risks involved in the execution of business activities specified in the strategy-setting" (risks associated with the execution of business activities)—and identify and manage new,

emerging, and changing risks.

Additionally, entities are constantly seeking new business opportunities and conducting internal corporate venturing to advance into new business areas and to continue to grow in today's highly competitive environment. However, to deal with the risks that accompany new opportunities, entities must be able to cope with uncertainties in their risk recognition process. In this connection, Sarasvathy (2001) proposed the concept of effectuation, a decision-making process for entrepreneurs to deal with uncertainties, and which is the opposite of causation.

This study focused on the necessity of making a distinction between measurable and unmeasurable "true" uncertainties when recognizing risks in today's business environment, which is characterized by radical changes and numerous uncertainties. Then, I proposed the new "application framework of effectuation and causation to quantifiable and non-quantifiable risks," which applies Sarasvathy's (2001) effectuation process to risks that are extremely difficult to quantify and the causation process to the risks that can be quantified, respectively Zones 1 and 2 of "Occurrence Frequency-Based Risk Management" (Uehara, 2002).

The application of this new framework to ERM could allow entities to not only distinguish risks between Zones 1 and 2, based on the respective risk recognition threshold, but also deal with each risk accordingly and implement occurrence frequency-based risk management with uncertainties.

However, guessing Knight's (1921) "true" uncertainties remains difficult. In recent years, a movement to theorize "experience-based guesses" has emerged among Bayesian statisticians. Two examples are the "Case-Based Decision Theory," which proposes extracting similar problems from past experiences and fitting it to a similarity function (Gilboa & Schmeidler, 2001), and "Inductive Game Theory," a game theory based on experience (Matsui, 1999). It is expected that the application of these theories will help business entities to estimate risks.

Furthermore, conducting agent-based simulations using the NK model (Kauffman, 1993; Levinthal, 1997) to determine the threshold for risk prediction accuracy of business entities may also contribute to the introduction of the "application framework of effectuation and causation to quantifiable and non-quantifiable risks" proposed in this study.

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