

# ENVIRONMENTAL UNCERTAINTY AND FIRM PERFORMANCE: AN EMPIRICAL STUDY WITH STRATEGIC ALIGNMENT IN THE HEALTHCARE INDUSTRY

*Completed Research Paper*

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## Abstract

*The healthcare industry is presently using information technology to transform itself. New strategies and tactics to increase efficiency and quality through the use of IT are being developed and implemented. Through this process, firms have to adapt to environment properly for their survival because environmental uncertainty can become either crises or opportunities and understanding environment is a pre-requisite to strategic settings. Despite these implications, little studies have been done with the nature of uncertainty of environment. In this study, we extend the concept of uncertainty to complexity-change and three types of uncertainty (state, effect, and response), and examine the relationship between the types of uncertainty and strategy, the impact of the fit between uncertainty and strategy on firm performance, and CEOs' attention to environment with information systems in the health care industry. Using 10-k documents of firms, we find that the degree of uncertainty is associated with strategic positions between efficiency-oriented strategy and market-oriented strategy, and state uncertainty dominantly affects strategic positions. We also find that the fit between state uncertainty and efficient-oriented strategy has a positive relationship with firm performance. We do not support the moderate role of information systems between uncertainty and strategy. Finally, we find that unbalanced attention of CEOs on external environment has a positive association with firm performance. The empirical results shed light not only on the understanding of characteristics of environmental uncertainty, but also on the designing of information systems to handle different types of environmental uncertainty.*

**Keywords:** Environmental Uncertainty; State Uncertainty; Effect Uncertainty; Response Uncertainty; Strategic Alignment; Firm Performance; 10-K document.

## Introduction

Just as the evolution of civilization is the result of external challenge and internal response of a society (Toynbee and Somervell 1947), the survival of a firm could be the outcome of external threats and internal reactions (Abebe et al. 2010; Karimi et al. 2004; Maier et al. 1997; Vandenbosch and Huff 1997). Among present economic sectors, the healthcare industry may have the most complex structure. Many idiosyncratic and fragmented stakeholders such as hospitals, clinic laboratories, pharmaceuticals, manufacturers for medical equipments, insurance companies, and government have intermingled with each other, and thereby preventing managers in firms from making sense of a situation and setting up strategies by forecasting the future (Sargut and McGrath 2011). The complex interest of the different actors have sometimes stymied innovations for improving health care at a lower cost, and moreover the complex system of payments or reimbursements that generally come not from patients but from insurers and government contributes the “bending the cost curve” in healthcare by introducing inefficiencies (Agarwal et al. 2010; Herzlinger 2006). Even in a hospital, the conflict between clinicians and administrators debilitates managing care, and the power struggle among hospitals, physicians, and insurance companies brings inefficient resource allocations (Brussee 1995; Michelman and Kim 1990). In addition, across all the actors, the government plays a influential role substantially as the chief policymaker with the extensive network of rules that can change the equilibrium among actors (Agarwal et al. 2010). In response to such environmental uncertainty, the healthcare industry is transforming to the efficient organizations through healthcare cost accounting system (Kaplan and Porter 2011), matching the clinician’s skill level to the difficulty of the medical problem (Christensen et al. 2000), a consumer-driven system (Herzlinger 2006), and new business model involving the horizontal or vertical integration of separate health care activities (Herzlinger 2006). In particular, information technology (IT) has been touted as a solution for soaring health care costs and a way to reduce medical errors (Agarwal et al. 2010; Venkatesh et al. 2007). Thus, in order to respond the external environment properly, firms have to identify emerging issues and potential pitfalls throughout environmental scanning, and to set matching strategies by exploiting internal resources.

Despite the importance of environment surrounding firms, a body of information systems (IS) studies pays little attention to the complicated and complex environment (Watson 1990; Xu et al. 2003), and shifts its focus toward the performance from alignment between business strategy and IS strategy (Chan et al. 2006; Chen et al. 2010; Kearns and Sabherwal 2007; Tallon 2007; Venkatraman 1989). By assuming that a firm generally has a single characteristic of prospector, analyzer, defender, or reactor (Miles and Snow 1978), researchers examine the relationship between performance and the degree of fit. For instance, it is assumed that a firm with the characteristic of a prospector is actively finding and exploiting new products and market opportunities. However, the assumption for the homogeneity of characteristic of a firm is too simple in the complex healthcare industry because a firm is likely to take different positions according to various environments. For instance, a firm can act as a defender for generally required electronic health record system mandated by the government, but simultaneously act as a prospector for developing information infrastructure. Besides, many information systems for responding to environmental uncertainty such as risk management systems (Alter and Sherer 2004; Benaroch et al. 2006; Suh and Han 2003) and executive information systems (Vandenbosch and Huff 1997) have developed by acknowledging the sectors or domains of environment such as suppliers, customers, legal domain, or social domain rather than the types of uncertainty (Maier et al. 1997). However, if we make individual system for uncertainty of various domains and take strategies for each domain, a few of systems and strategies can be overlapped because of the multiplicity of various domains in the healthcare industry, and thus hindering consistent strategies across domains (Sargut and McGrath 2011). Indeed, environment around firms has two important characteristics. First, environment is one of the main sources of uncertainties, and thus, “scanning environment is an obvious pre-requisite to aligning competitive strategy with environmental requirements (Davis et al. 2008 p.82).” Second, uncertainty of environment can become either crises or opportunities to firms (Albright 2004; Daft et al. 1988; Karimi et al. 2004). Thus, in this study, we examine the relationship between the types of uncertainty and strategy, the impact of the fit between uncertainty and strategy on firm performance, and Chief Executive Officers’ (CEOs) behavior of attention to environment, particularly information systems, in the healthcare industry.

This study can contribute to information systems literature as follows. First, we measure the types of uncertainty of firms in the healthcare industry with complexity-change and three types of uncertainty including state, effect, and response uncertainty (Milliken 1987). In the complexity-change, *complexity* deals with uncertainty in a specific time and *change* deals with dynamics of uncertainty according to time flow. Three types of uncertainty are classified in terms of the nature of uncertainty. We believe that two different measurements of uncertainty will be helpful to understand the nature of uncertainty and developing IS in the healthcare environment. The extant literature, in general, identified the uncertainty of environment with internal-external, task-general, stable-unstable, or simple-complex structure (Daft et al. 1988; Ray et al. 2009; Vandenbosch and Huff 1997). However, those classifications are feasible after CEOs recognize environment with some extent of certainty. Second, we investigate the relationship between the types of uncertainty and strategy, and examine the impact of the strategic alignment to uncertainty on firm performance. Lastly, we investigate the relationship between CEOs' balanced attention to both internal and external environment and firm performance. According to firms' strategies, CEOs are able to envision IS as an opportunity or an obstacle. If CEOs consider IS as a strategic tool that offers members high quality of health care and squeezes out excess costs, they will take profound interest in IS. On the other hand, when integrating heterogeneous health information systems throughout merger and acquisition, CEOs can consider the integration of IS as a problematic task (Khoumbati et al. 2006; Main and Short 1989). We believe that the understanding of environment in terms of the types of uncertainty and the impact of strategic alignment to environment not only help researchers get an insight on uncertainty, but also support top managers to implement proper strategies for uncertainty in the healthcare industry.

We have organized the rest of this study as follows: We first review literature and present our research framework for uncertainty, strategic alignment (fit), and firm performance. Then, we describe our research methodology including a discussion of our sample, variables, and the measurement of those variables. Next, we present the results of our analysis, discuss our findings, and highlight the implications of our research. Limitations and directions for future research are presented before the paper is concluded.

## Literature Review

The terms of environment, uncertainty, and risk in IS literature have generally been used without explicit definitions of concepts. Although those terms are loosely connected each other, more clear definitions as well as concrete examples for the terms will avoid the confusion of the discussion.

### *Environment and Health Care*

The concept of environment has been mainly used as external environment that corresponds to internal environment, meaning business area outside the boundary of a firm (Choudhury and Sampler 1997; Karimi et al. 2004; Watson 1990). This definition is in conformity with that of strategic domain literature that defines the environment as "the relevant physical and social *factors outside* the boundary of an organization that are taken into consideration during organizational decision making (Duncan 1972)." In this definition, we notice that environment is defined as *outside* the boundary of an organization. However, inside and outside are two sides of the coin, and we are able to call inside the boundary of an organization as environment too. Extant literature treats factors within a firm as resources, but the resources can be threats or resources according to a firm's environment. Thus, we argue that the inclusion of internal environment is required to better understand environment.

The main goal of health care is to provide people with the better quality of health care service at a lower cost. The outside of the healthcare environment can be characterized with three properties including multiplicity, interdependence, and diversity (Sargut and McGrath 2011). The first, multiplicity, refers to the number of components such as hospitals, insurance companies, and pharmaceuticals. Interdependence is related with interactions among components, and lastly diversity is associated with the degree of heterogeneity. For example, *Fortune 500* does not contain a specific "healthcare" industry (*Fortune500* 2011). Instead, it lists up health care related industries such as medical facilities, managed care, medical products and equipment, pharmaceuticals, and insurances. Compared to other industries, health care has eight sub-industries and next food industry have four sub-industries in *Fortune 500*. Besides, the diverse components are intertwined each other, the failure of one component causes severe problems on the whole in health care. For instance, a preferred provider organization in a local

community leans on clinical laboratories for diagnosis service. Therefore, if the clinical laboratories do not provide diagnosis result on time, local hospitals cannot cure patients quickly. Herzlinger (2006) enumerates six forces that affect the innovation of health service including industry players, funding, policy, technology, customers, and accountability. In fact, due to the high multiplicity, interdependence, and diversity, the healthcare industry has four peculiar characteristics; a) health service is provided through diverse organizations, b) there is a severe information asymmetry problem between physicians and patients, c) the majority of payments for health care services comes from a third party such as insurance companies or government, d) the healthcare industry is heavily regulated by many rules established by the government (Agarwal et al. 2010).

### ***Uncertainty, Risk, and Health Care***

Uncertainty is defined as “an absence of information” (Karimi et al. 2001) or “an individual’s perceived inability to predict something accurately (Milliken 1987).” In this definition, we find that uncertainty is originated from the *unavailability* of information and *unpredictability* for the future. Because of the lack of available information, the prediction of the future can be imprecise. Thus, many IS have been developed to glean external information or to scan environment (Choudhury and Sampler 1997; Karimi et al. 2004; Vandenbosch and Huff 1997). In the healthcare industry, uncertainty can amplify unintended consequences particularly when events interact without anyone meaning them to (Sargut and McGrath 2011). For instance, as the medical knowledge has advanced, medical schools have turned out many specialists and improved the quality of health service. At the same time, too many specialists have boosted up the health care costs but the consequence was not expected at the first time (Levin-Scherz 2010).

On the contrary, *risk* assumes that we are able to guess or know, to the extent, the likelihood of events with available information. Then, the degree of risk can be described as probabilities of events. The risk of IT is defined as “the likelihood and potential impact of an unplanned IT event compromising one or more business objectives (Westerman 2009 p.12)” or “risk is present when an asset is vulnerable to a threat (Rainer Jr et al. 1991 p.130).” Thus, risk is something that can be calculated or known while uncertainty is something unknown or chaotic. If a disease is in the level of risk, the medical treatment for the disease can be standardized with a proven therapeutic strategy (Christensen et al. 2000).

In sum, environment causes uncertainty, and as available information inflow, the degree of risk can gradually be measured with certainty. In this study, we focus on the stage of uncertainty that is before the stage of risk because timeliness of information is crucial for decision making, and environment is filled with vague elements that are difficult to convert to probabilities.

### ***State, Effect, and Response Uncertainty***

We examine uncertainty of environment from two perspectives; complexity-change and the characteristics of uncertainty. In the complexity-change, complexity denotes a number of sources of uncertainty and change denotes dynamics according to time flow. The uncertainty of environment can be characterized as state, effect, and response uncertainty that are proposed by Milliken (1987). State uncertainty, first, is related to a situation that “one does not understand how components of the environment might be changing (Milliken 1987 p.136).” For instance, to a general hospital, it is uncertain whether the government will deregulate stem cell therapy or about the likely behavior of competitors if deregulation occurs. Thus, in this case, the hospital does not know either the probability of deregulation or the probability of competition for adopting stem cell therapy if deregulation occurs. Also, state uncertainty is not tied to assessing the probable consequences of a decision. Then, the uncertainty of whether new drug will pass the test of FDA is not related with state uncertainty. The healthcare industry is likely to have experience of state uncertainty compared to other industries because of complexity and heterogeneity characteristics.

A second type of uncertainty is related to an individual’s ability to predict “what the impact of environmental events or changes will be on his/her organization (Milliken 1987 p.137).” For instance, a double-dip in an economy may or may not affect his/her pharmaceutical company, and thus the manager of the focal firm is uncertain about the likelihood of influence of the double-dip to the firm. In another case, one may be very sure that the number population of 70-80 year-olds in the country will increase, but

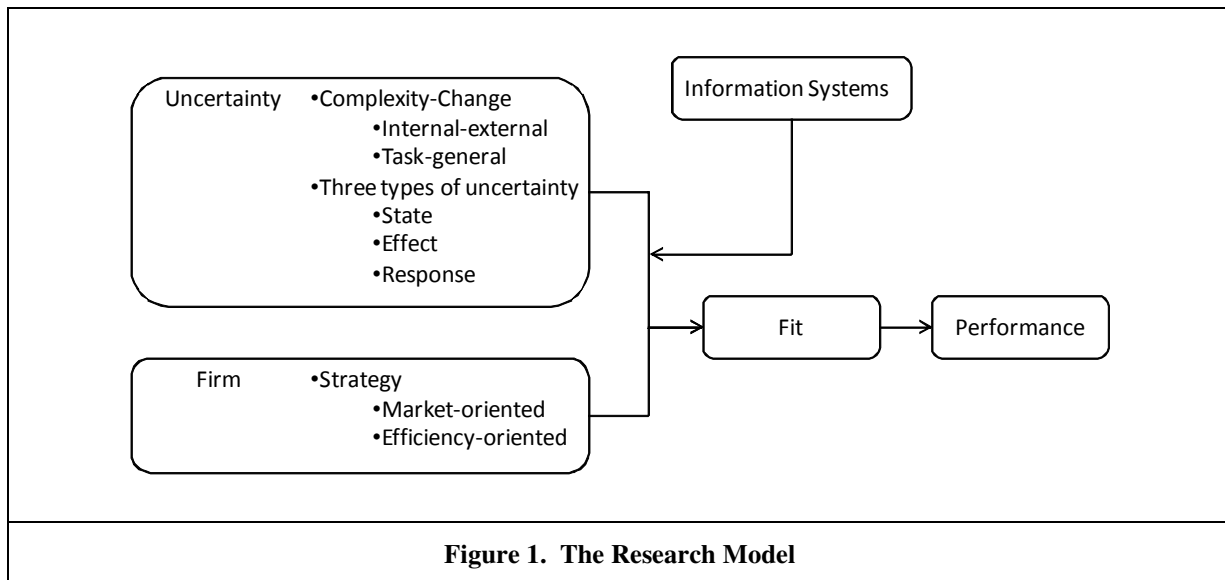
unable to predict that the change will bring sales growth of a product of the company. The lack of understanding of cause-effect relationships can lead to effect uncertainty.

Lastly, response uncertainty is associated with attempts to understand “what response options are available to the organization and what the value or utility of each might be (Milliken 1987 p.137).” Thus, when making a decision to choose one option from a number of possible strategies, CEOs are likely to feel the highest response uncertainty. For instance, when the government forces to adopt electronic health record, a CEO in a general hospital will encounter the difficulty of selection between in-house making and outsourcing. Response uncertainty is important when pending event or change is perceived as a threat for survival or an opportunity to firms’ growth.

We believe that two perspectives of uncertainty can supplement the previous concept of uncertainty such as stable-unstable and simple-complex environment. Moreover, three types of uncertainty provide an insight to design and implement information systems. To the state uncertainty, information systems that allow wide scanning environment are adequate, but to the effect uncertainty, information systems that reveal the relationships of cause-effect are proper. To the response uncertainty, information systems that make a scenario according to various options will be appropriate.

### ***A Research Model and Theoretical Background***

Contingency theory in organizations posits that “there is no one best way to organize in all situations (Lawrence and Lorsh 1967 p.3)” and takes a relative position that the effectiveness of organizations can be different under different economic and technological conditions. The theory has a comprehensive influence on IS research with the concept of *fit* or *alignment* (Becerra-Fernandez and Sabherwal 2001; Weill and Olson 1989), that under the concept of fit, it is assumed that the better fit among variables, the better the performance or effectiveness. Because healthcare firms are surrounded by a complex environment and they can respond differently to the same environment, the understanding of the characteristic of firms as well as the characteristics of uncertainty are important to identify the relationship between environmental uncertainties and firms. However, the characteristics of environments of firms are so quietly complex that a holistic view considering many variables at the same time may be impossible. Thus, the previous literature classified environment in terms of domain or sector for causing uncertainty.



The domain of environment has been classified with internal-external (Garg et al. 2003) and task-general (Karimi et al. 2004; Lawrence and Lorsh 1967). Whereas task domain contains customers, suppliers, or competitors, general domain contains economic, legal, or social environment (Daft et al. 1988; Duncan 1972; Maier et al. 1997). Also, the environment has been classified in terms of the characteristic of

environment for causing uncertainty including dynamics (stable-unstable), complexity (simple-complex), hostility (capacity-munificence) (Daft et al. 1988; Lawrence and Lorsh 1967). Instead, we enrich the classification with the three types of uncertainty such as state, effect, and response uncertainty by Milliken (1987) as well as complexity-change uncertainty.

The extant literature focuses on scanning behavior of top managers in which firm performance depends upon the fit between scanning behavior and environment (Choudhury and Sampler 1997; Vandenbosch and Huff 1997; Watson 1990). Karimi et al. (2004) investigated whether unstable and complex environment force CEOs to pay attention to non-routine tasks and thereby reduce satisfaction. Maier et al. (1997) found that a firm with high performance takes environment scanning frequently. Auster and Choo (1994) found that environment uncertainty is positively associated with the number of scanning, and information gleaned from scanning is mainly used to improve organizational efficiency and to set business strategies. Although those studies attempted to find the characteristics of scanning behaviors and the relationship with environment uncertainty, two limitations are salient. First, in terms of methodology, the studies employed self-reporting or subjective judgments of CEOs and did not use objective data to measure the complexity and dynamics of environment. Second, the studies focused on sources or sectors of environment uncertainty and did not consider the three types of uncertainty, including state, effect, and response uncertainty. Given the circumstance that the healthcare industry is transforming using information systems such as standardized healthcare systems and large-scale IT integration, the understanding of environmental uncertainty with respect to three types of uncertainty facilitates different management according to the types of uncertainty (Wilson and Lankton 2004). For instance, in the case of state uncertainty, information systems emphasizing environment scanning such as executive information systems is required for a firm. Also for the effective uncertainty, information systems emphasizing advanced analytics and business intelligence to find relationship between causes and effects will be demanded. Thus, by incorporating three types of uncertainty, we set the research model which is shown in Figure 1.

From the model we particularly investigate the relationship between the types of uncertainty and strategy, the impact of the fit between uncertainty and strategy on firm performance, and CEO's attention to IS component in the healthcare environment. Using 10-k documents of firms, we measure the uncertainty of environment and strategic alignment to uncertainty, and test the impact of the alignment on firm performance. While interviews and survey offer advantages such as the opportunity to collect information not publicly available, a research plan to interview each of the CEOs of many healthcare firms is practically not possible. Additionally, some have argued that 10-k documents provide more objective information and allow objective comparisons because of a unified form regulated by Security Exchange Commission (SEC) (Bettman and Weitz 1983; Chang et al. 2003). Finally, the use of 10-k documents ensures that better-known firms will not be over-represented that is a frequently occurring bias when using news articles or press releases.

### ***Strategic Alignment to Environment***

The strategic object should be a single object that will drive the business over the next few years and should be attainable (Collis and Rukstad 2008). For instance, because of trade-off between growth and profitability, a firm pursuing cost-driven could not attain growth at the same time. Based on the framework of Treacy and Wiersema (1997), we first classify firm strategy with four types of strategies including internal growth, external growth, operating efficiency, and customer satisfaction as shown in Table 1. Internal Growth object is about the strategy to promote profits, to secure new customers, and to expand services. For instance, the strategy to increase the number of customers by providing online healthcare services belongs to internal growth. It is home-grown business activities by ensuring that the resources such as skilled work force and available technology are exploited fully to expand the size of a firm (Duberman 1990; Sherman 2003). External Growth is about the strategy to expand the size of a firm by establishing alliances, securing new markets, and expanding new products (Duberman 1990). Merger and acquisition is one of typical ways to expand the size of a firm. Because internal growth and external growth have the same purpose to expand the size of a firm, we combine two strategies and refer to it as market orientation strategy for growth. We refer to Operating Efficiency as Efficient orientation strategy. Operating Efficiency seeks a variety of cost saving such as administrative costs and overhead costs, and emphasizes the value-for-money. The strategy for customer satisfaction is allocated into market orientation strategy or efficiency orientation strategy according to the purpose of customer satisfaction

strategy. If customer satisfaction strategy is to expand the size of market share, that strategy is classified as market orientation strategy. In short, while market orientation strategy emphasizes breadth of products, innovation, and new customers, efficiency orientation strategy puts weight on cost control (Kumar et al. 1993).

We postulate that as environment become complex and volatile, firms will take efficiency orientation strategy because of the inflexibility of strategy. If a firm takes a strategy once, the change of the strategy will be difficult when the environment changes. Instead, if environment is simple and stable, firms will take market orientation strategy for their growth. Kumar et al. (1993) find that firms for growth-orientation is looking for exploiting opportunities and firms for efficiency-orientation is looking for uncovering threats.

Objectives	Internal Growth	External Growth	Operating Efficiency <sup>1</sup>	Customer Satisfaction <sup>1</sup>
Strategic Focus	Profits; New customers; Expanding services	Economy of scale; leadership; New segment market; New business	Seek operating efficiency with few errors and high quality; Emphasize value-for-money	Understand specific customer needs; customers will pay for a premium level of service
Role of IT	New contract support; support to develop new product; identify necessary products	Technology leadership	Lowering overhead cost; Cost savings	Offer personalization and mass customization; Better service
IT systems	Contract research service; Shared value management system; E-commerce	Chief technology officer; Knowledge analytic system	Database management system; Billing information system; Reporting system; E-learning system	Customer relationship management; Customer complaints management system

1. Source: Adapted from (Treacy and Wiersema 1997) and (Tallon 2007)

Based on this rationale, we hypothesize that:

*Hypothesis 1(a): The degree of uncertainty of environment is associated with strategic positions.*

We also test the relationship between three types of uncertainty (state, effect, and response uncertainty) and two strategies (market and efficiency strategies). A state type of uncertainty involves an incomplete understanding of future states with the lack of available information. Because managers cannot predict the future state with certainty, they will postpone high risk strategies such as alliance with other partners and the development of new drug to the future until the future state becomes clear. Thus, we conjecture that state uncertainty will have a positive relationship with efficiency orientation strategy. An effect uncertainty involves the uncertainty of implications of a given state. For instance, we may be certain that the government will pass the policy to development of new drug using stem cells, but we may not sure that how much such policy may impact on our company. Thus, state type of uncertainty has the highest environmental uncertainty, and effect and response type of uncertainty have next level of uncertainty. A response type of uncertainty involves the uncertainty of available options for making strategies. Therefore, effect and response uncertainty have a positive association with market orientation strategy because response uncertainty can be uncertainty after decision making and effect uncertainty can be uncertainty of effect of a given strategy. Based on the foregoing rationale, we hypothesize that:

*Hypothesis 1(b): A state type of uncertainty is positively associated with efficiency orientation strategy, and effect and response strategy are positively associated with market orientation strategy.*

## **Strategic Alignment to Environment and Firm Performance**

Firms will take different strategies to adapt to different environment, which in turn produce different outcomes. We test the effect of fit between environmental uncertainty and strategy on firm performance. We postulate that a firm with high fit will have a high firm performance. If a firm fails to identify environment correctly or uses inappropriate strategy in spite of the correctly identified environment, the outcomes of the firm decrease. When matching environmental uncertainty and strategy, we use the relationship between three uncertainties (state, effect, and response uncertainty) and two strategies (market and efficiency strategies). For state uncertainty, efficiency strategy is regarded as a right fit, and for effect and response uncertainty, market strategy is deemed as a right fit. For instance, in the case of the development of new drug using stem cells, a pharmaceutical firm may have state uncertainty about whether the government regulates or deregulates the drug development using stem cells. In this circumstance, the firm cannot affect the decision making of the government, and just has to wait the final decision of the government. Then, the firm will be conservative and take efficient orientation strategy by reducing costs of the research and development for a while. Instead, effect uncertainty is about the uncertainty given that the government deregulated the development of new drug using stem cells. In addition, response uncertainty is about the uncertainty caused by taking one of alternative strategies. Because in the last two cases, the firm to some degree can control its action and thus the outcome can be affected by the firm's decision, and will pour out all efforts to product best outcome. Although the fit is likely to change with respect to environment, top managers tend to be reluctant to change their strategies, and when they face external pressure, they "tend to adjust rather than to change their strategies" (Snow and Hambrick 1980). Then, an organization that seeks ostensibly change of strategy can just adjust its strategy in reality. Also, top managers are generally interested in finding right type of fit (Tallon 2007). By assuming the persistence of strategy of a firm, we hypothesize that:

*Hypothesis 2(a): The fit between environment uncertainty and firm strategy is positively associated with firm performance.*

Health care information systems have been argued to have important effects on efficiency through reducing costs (Angst et al. 2011). Studies have reported that IT contributes positively to the production of services with lower costs (Menon et al. 2000) and higher productivity (Baker et al. 2008). By classifying health information systems into clinical IS and administrative IS, Menon et al. (2009) have reported that clinical IS improves hospital output in the short run (within two years), but administrative IS has a positive association with performance over the long run (after four years). Moreover, health information systems play a key role in transforming the health care industry by reducing medical errors and implementing large-scale IT integration among health care companies (Braa et al. 2007; Main and Short 1989; Wilson and Lankton 2004). If information systems indeed are helpful for managers by providing available information to their decision making, IS will moderate the relationship between environment and performance. Based on this rational, we hypothesize that:

*Hypothesis 2(b): The effect of the fit between environment uncertainty and firm strategy on firm performance will be different according to the level of IS use.*

## **CEOs' attentions on Environment**

We test the relationship between balanced attention of CEOs to both internal and external environment and firm performance. Although environment can be conceptualized with both internal and external structure (Garg et al. 2003), previous studies mainly pay more attention to the external environment (Davis et al. 2008; Ebrahimi 2000; Garg et al. 2003). However, we conjecture that better performance can come from balanced interests of CEOs in both internal and external environment. By watching carefully internal environment such as organizational culture and morale of employees, CEOs are able to set appropriate strategy for response uncertainty. Alder-Milstein (2009 p.20) have commented that "the hoped-for efficiency and quality gains from electronic records and related applications will evaporate if hospitals and medical practices don't support them with organizational changes such as increased individual decision making authority and more training." In particular, the management of intangible assets within companies such as specialized knowledge and skills of employees leads to innovations and gives comparative advantages (Eisenhardt and Martin 2000). On the contrary, the factors in the internal environment can hamper a firm's growth. For instance, when a pharmaceutical company attempts to



expand its market share through merger and acquisition of another firm, heterogeneous IT infrastructure of two companies can be an obstacle to the integration of IT. Likewise, the external environment is also critical to a firm's success and survival especially during the complex and turbulent market conditions. Based on this rationale, we hypothesize that:

*Hypothesis 3(a): Balanced attentions of CEOs on internal and external environment have a positive association with firm performance.*

For state uncertainty, firms have to scan a lot of information over wide areas of components. Also for effect uncertainty, firms have to employ many advanced analytical methodology and to find the cause-effect relations. Lastly, for response, firms have to precisely evaluate the performance for each alternative strategy. For any types of uncertainty, IS play crucial roles for scanning information, advanced analysis, evaluating the value of strategies. In particular, information system that helps to scan a lot of information aids CEOs to formulate problems and foster creativity. Instead, information system that helps to solve specific problems can mitigate effect uncertainty (Vandenbosch and Huff 1997). However, many information systems to scan environment are designed to collect information from external environment (Auster and Choo 1993; Choudhury and Sampler 1997; Davis et al. 2008; Maier et al. 1997; Watson 1990). As a consequence, CEOs can perceive that information systems for environmental scanning are mainly for external environment. Thus, we hypothesize that:

*Hypothesis 3(b): CEOs pay more attention to information systems for external environment than for internal environment.*

## Sample

The healthcare industry is presently using IT to transform itself. New strategies and tactics to increase efficiency and quality through the use of IT are being developed and implemented (Anderson et al. 2006). We select the healthcare industry as a sample because of two reasons. First, this industry has witnessed rapid environmental changes, severe competitions, and immense efforts to reduce costs from healthcare reforms. Then, we expect that the industry contains various levels of complexity and volatility, and this characteristic helps to test aforementioned hypotheses about environmental uncertainty. Second, there is a great need to improve organizational performance in the healthcare industry because it has been observed that the healthcare costs in developed countries have begun to threaten those countries' competitive advantage in the global marketplace (Prahalad 1999). IT may be one such way to improve performance and reduce costs.

### Sample Selection

In order to get the full list of companies in the healthcare industry, we have first identified five healthcare related industries using the classification of *Fortune 500* including "health care: medical facilities", "health care: pharmacy and other services", "health care: insurance & managed care", "pharmaceuticals", and "medical product & equipment." Then, using Mergent Online database (<http://www.mergentonline.com>), we searched all companies obtained from *Fortune 500*, and collected the list of sectors including Biotechnology, Diagnostic & Health Related Services, Medical Instruments & Equipment, Pharmaceuticals, General Insurance, and Hospitals & Health Care Facilities. After that, we collected companies that reported 10-k in 2008. We chose year 2008 because the year is relatively recent year, and produced 179 companies in that year. Because companies with more than \$10 million in assets and a class of equity securities that is held by more than 500 owners must file annual and other periodic reports, small size of companies were excluded. Then, by applying the random selection method according the proportion of sectors and by setting the total number of companies with 60, we have finally selected 60 companies; Biotechnology 31/95, Diagnostic & Health Related Services 2/5, Medical Instruments & Equipment 2/6, Pharmaceuticals 19/57, General Insurance 2/6, and Hospitals & Health Care Facilities 4/10.

After selecting the firms for the sample, we have collected 10-k documents. The average number of pages is 106 and the number of words is 59,163. The average market capital is around 85 billion, and the average net income is around negative 14 million. A typical 10-k report includes 15 items from description of business, risk factor, legal proceedings, to executive compensation. Because firms have to follow a specific

form for reporting, these 10-k documents will improve comparability among firms. In particular, Item 1A, *risk factors* in a 10-k document contains detailed information about firms' environment, and thus the analysis for this section will give an alternative way for strategy and environment study to supplement the previous survey study. Also, in the item 1A of risk factors, the company lays out anything that could go wrong, likely external effects, possible future failures to meet obligations, and other risks disclosed to adequately warn investors and potential investors. Thus, in order to mitigate the subject bias prevalent in the survey study, we use content analysis using 10-k documents of firms.

## Methodology

### Variables

*Uncertainty.* We have conducted content analysis using 10-k document of firms. For complexity-change uncertainty, we have firstly measured the complexity of uncertainty of environment in a firm by counting the number of risk factors in item 1A of 10-k documents. Because complexity comes from different sources of uncertainty, and risk factors in item 1A deal with uncertainty, we used the number of risk factors in item 1A as a proxy for the degree of the complexity of uncertainty. We then calculated the degree of the change of uncertainty with the number of the word "change" in a 10-k report. We excluded other meanings of change such as profit change or financial change with manual inspections. Then, we normalized complexity counts as well as change counts, and then summed up normalized complexity and change and make an index for complexity-change. For normalization, we use normalization in range  $<-1,1>$  with  $((x-\text{mean})/\max(\text{abs}(x-\text{mean})))$  formula. Therefore, the range of complexity-change index will be from -2 to 2 because each index has the value from -1 to 1.

For state, effect, and response uncertainty, we have applied content analysis for the item 1A, risk factors. By following the definition of three types of uncertainty (Milliken 1987), we have assigned each risk factor in item 1A of a 10-k into one of categories of uncertainty. For the precise classification, two authors independently assigned risk factors into one of uncertainties and if there was incongruence for classification, another author determined the final classification. For making a single index for uncertainty, we have used normalization in range  $<-1,1>$ , applied to three types of uncertainty, and summed up a single index of uncertainty. Thus, the uncertainty index ranges from -3 to 3. The reason to use normalization in range is for interpretation of low and high uncertainty with respect to zero value.

For the classification of market and efficiency strategy, we have used the same 10-k documents but elicited strategy a firm taken from item 1 (description of business), item 2 (description of properties), and item 7a (quantitative and qualitative disclosures about market risk). Then we have counted the number of strategy for market orientation strategy and efficiency orientation strategy respectively according to the classification that are described in Table 1.

For the hypothesis 3(a) and 3(b), we classify risk factors according to internal and external environment and count the number of risk factors for two environments. Based on internal and external environmental classification, we count the number risk factors containing information systems for each environment.

*Performance.* Many measures to gauge firm performance have been developed, but generally the measures can be divided into accounting-centric measure and stock market measure (Chang et al. 2003; O'Sullivan and Abela 2007). For the accounting centric measures, Return on Assets (ROA), Return on Sales (ROS), Return on Investment (ROI), and Return on Equity (ROE) are generally used for calculating firm performance because of simplicity and easiness to understand those ratio. Also, because there are usually high correlations among profitability measure, in this study, we use ROA as a main proxy for firm performance.

*Control.* We have controlled the size effect by incorporating the number of employees in a firm. We take log for the number of employee for regression analysis (Bharadwaj et al. 1999; Chang et al. 2003; Ravichandran et al. 2009).

### Analysis

Hypothesis 1 is about the relationship between uncertainty and strategic positions. In hypothesis 1(a), we hypothesized that the degree of uncertainty of environment is associated with strategic positions. In

hypothesis 1, we assume that high uncertainty is associated with efficiency orientation strategy and low uncertainty is associated with market orientation strategy. Because we measure uncertainty from two perspectives, complexity-change and three uncertainties (state, effect, and response), we test hypothesis 1(a) from two perspectives. We have normalized each measure of uncertainty and conducted logistic regression analysis. Table 2 shows the result.

Table 2. The Relationship Between Uncertainty and Strategic Position			
Strategic Position (Market for 1 and Efficiency for 0) = $\beta_0 + \beta_1 \text{Uncertainty} + \varepsilon$			
Complexity-Change measure <sup>1)</sup>		Three uncertainties measure <sup>2)</sup>	
$\beta_1 \text{Uncertainty}$	0.91 (t=5.21, p<0.0001)	$\beta_1 \text{Uncertainty}$	0.87 (t=4.78, p<0.0001)
<i>Note:</i> 1) By normalizing the value of complexity and change measure, we add two values for one index. 2) By normalizing the value of state, effect, and response uncertainty, we add three values for one uncertainty index.			

First, for the complexity-change measure, the coefficient for uncertainty is 0.91 and the value is significant at the level of 1% (t=5.21, p<0.0001). Second, for the uncertainty measure, the coefficient is 0.87 and the value is significant at the level of 1% (t=4.78, p<0.0001). The results of two tests support the hypothesis 1(a) that uncertainty has a positive association with strategic positions. In particular, the low degree of uncertainty is associated with market-oriented strategy and the high degree of uncertainty is associated with efficiency-oriented strategy.

Hypothesis 1(b) is about the relationship between three types of uncertainties and strategic positions. We conduct two regression analyses, regressing market-oriented strategy and efficiency-oriented strategy on state, effect, and response uncertainty. In this case, we use count measure for each strategy but use normalized measure for three uncertainties. Table 3 shows the result.

Table 3. The Relationship Between Three Types of Uncertainties and Strategic Positions		
Efficiency Orientation Strategy = $\beta_0 + \beta_1 \text{State} + \beta_2 \text{Effect} + \beta_3 \text{Response} + \varepsilon$		
Market Orientation Strategy = $\beta_0 + \beta_1 \text{State} + \beta_2 \text{Effect} + \beta_3 \text{Response} + \varepsilon$		
Efficiency Orientation Strategy		
$\beta_1 = 0.13$ (t=4.36, p<0.0001)***	$\beta_2 = 0.18$ (t=1.57, p=0.12)	$\beta_3 = 0.06$ (t=2.13, p=0.03)**
Market Orientation Strategy		
$\beta_1 = 0.33$ (t=3.24, p=0.002)***	$\beta_2 = 0.40$ (t=1.00, p=0.32)	$\beta_3 = -0.01$ (t=-0.19, p=0.84)
<i>Note:</i> *** denotes 1% significance level, ** denotes 5% significance level, and * denotes 1% significance level.		

For both efficiency orientation strategy and market orientation strategy, only state uncertainty affects a positive influence on strategic positions. Instead, response uncertainty only has a positive association with efficiency orientation strategy. We find that state uncertainty has a positive association with efficiency orientation strategy as well as market orientation strategy, although the effect for market orientation strategy is larger. Therefore, we partially support the hypothesis 1(b) that a state uncertainty is associated with efficiency orientation strategy, but effect and response strategy do not affect the market orientation strategy.

Hypothesis 2(a) tests the effect of the fit between environmental uncertainty and strategy on firm performance. We calculate the fit between state uncertainty and efficiency orientation strategy as the difference between  $N(\text{state}) - N(\text{efficiency})$  where  $N$  denotes normalization function, and name it as  $\text{state\_efficiency\_fit}$ . Also, we calculate the fit between effect and response uncertainty and market orientation strategy with  $N(N(\text{effect}) + N(\text{response})) - N(\text{market})$ , and name it as  $\text{effect\_response\_market\_fit}$ . Then, we make two regressions using  $\text{ROA} = \beta_0 + \beta_1 \text{state\_efficiency\_fit} + \beta_3 \text{size} + \varepsilon$  and  $\text{ROA} = \beta_0 + \beta_1 \text{effect\_response\_market\_fit} + \beta_3 \text{size} + \varepsilon$ . Table 4 shows the result.

Table 4. The Relationship Between The Fit and Performance	
$ROA = \beta_0 + \beta_1 \text{state\_efficiency\_fit} + \beta_2 \text{size} + \varepsilon$ $ROA = \beta_0 + \beta_1 \text{effect\_response\_market\_fit} + \beta_2 \text{size} + \varepsilon$	
The fit between state uncertainty and efficiency orientation strategy	
$\beta_1 = -0.78$ (t=2.32, p=0.023)**	$\beta_2 = 0.000016$ (t=0.73, p=0.46)
The fit between effect and response uncertainty and market orientation strategy	
$\beta_1 = -0.28$ (t=-0.86, p=0.39)	$\beta_2 = 0.000018$ (t=0.79, p=0.43)
Note: *** denotes 1% significance level, ** denotes 5% significance level, and * denotes 1% significance level.	

In order to support the hypothesis 2(b), the coefficient value,  $\beta_1$ , need to be negative value because larger fit has small value. In both fits, the signs of coefficients have negative values but only the fit between state uncertainty and efficiency orientation strategy is significance at the 5% level. The size variable is not significant at all for both cases. Thus, we support the positive relationship for state uncertainty and efficiency orientation strategy, but do not find the positive relationship for effect and response uncertainty and market orientation strategy.

Hypothesis 2(b) test the moderate role of IS between strategic fit and firm performance. We test the moderate role of information systems between fit and performance with  $ROA = \beta_1 + \beta_2 \text{IS} + \beta_3 \text{IS} * \text{FIT} + \beta_4 \text{size}$ . If  $\beta_3$  is positive and significant, we can interpret the result as supporting hypothesis 3(b). We use two FIT measures obtained from hypothesis 2(a). In addition, we measure the IS variable with the number of information systems that are mentioned in item 1A that is the risk factor item section. Table 5 shows the result. For both fits, we do not find a positive moderate role of information systems on performance.

Table 5. The Moderate Effect of IS between Strategic Fit and Firm Performance		
$ROA = \beta_1 + \beta_2 \text{IS} + \beta_3 \text{IS} * \text{FIT} + \beta_4 \text{FIT} + \beta_5 \text{size} + \varepsilon$		
The fit between state uncertainty and efficiency orientation strategy		
IS	IS*FIT	FIT
-0.23 (t=-1.30, p=0.21)	0.16 (t=1.58, p=0.12)	0.0001 (t=1.05, p=0.30)
The fit between effect and response uncertainty and market orientation strategy		
IS	IS*FIT	FIT
0.002 (t=0.02, p=0.98)	-0.0006 (t=-0.01, p=0.98)	0.000007 (t=0.79, p=0.43)
Note: *** denotes 1% significance level, ** denotes 5% significance level, and * denotes 1% significance level.		

Lastly, we test the hypothesis 3(a) that balanced attention of CEOs to both internal and external environment have a positive association with firm performance. In order to measure the balanced attentions of CEOs on internal and external environment, we classify each risk factor in item 1A with internal environment and external environment, and then take absolute value of the difference between the number of risk factor on internal environment and the number of risk factor on external environment. Then, we apply a regression analysis using the formula,  $ROA = \beta_1 + \beta_2 \text{Balanced\_Attentions} + \beta_3 \text{size} + \varepsilon$ . The regression result shows that the *Balanced\_Attentions* variable has 0.018 (t=1.71, p=0.09). However against the hypothesis 3(a), unbalanced attentions have a positive association with firm performance.

The hypothesis 3(b) is that firms pay more attentions to IS in external environment than IS in internal environment. For testing this hypothesis, we count the number of IS for each environment, and calculate the two ratios, IS to Internal and IS to External. Then, we conduct a *t*-test to see the group difference. Based on the test, we fail to reject the null hypothesis at the 1% significance level (t=2.98, p=0.005). The average of IS to internal environment is 0.04, and the average of IS to external environment 0.06. Thus, the result indicates that firms give more attention on IS to external environment.

## **Discussion**

The previous results show that the degree of uncertainty is associated with strategic positions between efficiency orientation strategy and market orientation strategy. However, for the test of the three types of uncertainty including state, effect, and response uncertainty on strategic positions, we find that only state uncertainty is associated with efficiency orientation strategy as well as market orientation strategy. This result implies that as environmental uncertainty increases, firms are likely to take efficiency orientation strategy than market orientation strategy, but the environmental uncertainty mainly comes from state uncertainty. Other two types of uncertainty, effect and response uncertainty, do not have an association with the strategic positions. The dominant state type of uncertainty reflects the extremely unpredictable and indefinable phenomena in the healthcare industry (Sargut and McGrath 2011). Because of many idiosyncratic and fragmented components and their complex interactions, the future state of other components that are likely to affect the corresponding component, especially the government, is unpredictable. Effect uncertainty is about the likelihood that a given event affects his or her company itself, and response uncertainty is about the selection difficulty among response strategies. Thus, effect and response uncertainty implicitly assume that there is little state uncertainty. In such tremendously uncertain circumstances, a few of studies in IT areas suggest that managers have to scan information over wide areas of components and formulate efficient strategies. Also, the studies suggest that information systems need to be developed for collecting widespread areas (Auster and Choo 1994; Daft et al. 1988; Ebrahimi 2000). In this sense, the healthcare industry can receive benefits by quickly introducing executive information systems to help broad information scanning and formulation of strategies on the top of electronic health care system for reducing medical record errors.

In the test of the effect of the fit between environmental uncertainty and strategy on firm performance, we find that only the fit between state uncertainty and efficient orientation strategy is positively related with firm performance. The finding implies that the healthcare industry can have direct benefit by taking operating efficiency strategies such as lowering costs and medical record errors. Indeed, the preventable medical errors rank as the at least sixth or eighth leading cause of death in the United States (Herzlinger 2006; Menon et al. 2009). Also, the amount costs spent in health care is about one-sixth (17%) of the U.S. gross domestic product. Given these circumstances, information systems such as electronic physician order entry, more accurate medication order and delivery, and better decision support will be far reaching (Menon et al. 2009; Wilson and Lankton 2004). Despite the positively expected roles of IS, we do not find the moderate role of IS in the study. One possible reason is that because the healthcare industry has implemented IT relatively slowly compared to other industries (Khoubati et al. 2006), full advantages using IT are not likely to be reflected in that industry. In fact, the evidence about the impact of health care information systems on firm performance is equivocal, with studies reporting positive (Baker et al. 2008), negative (Devine et al. 2010), and neutral. Agarwal et al. (2010) attribute plausible reasons to different sample and time period as well as different types of healthcare information systems.

We also find that unbalanced attention of CEOs to external environment have a positive relationship with firm performance. The finding implies that quality gains and cost savings from adopting healthcare information systems can be obtainable after figuring out environmental uncertainty and then by utilizing internal resources such as organizational change of culture and specialized skills and knowledge of employees. However, several studies suggest that it is possible to implement standardized health care services for typical types of diseases using internal resources such as adequate clinician's skill level to the treatment of diseases, and thereby reducing soaring health care costs (Bohmer 2010; Christensen et al. 2000; Levin-Scherz 2010). For the creation of clinician's knowledge system, various experiences from knowledge management systems and decision support systems in IT area can contribute to the development of such system. Lastly, we find that CEOs pay more attention to external environment than internal environment. Among external environment, we find that managers have high interest in government regulation in the healthcare industry. This phenomenon illustrates that because the healthcare industry is regulated by many governmental agencies such as FDA or relevant laws, and many healthcare firms rely on the reimbursements of government's Medicaid and Medicare programs, CEOs are likely to show more attention toward these external environment.

## **Theoretical Implications**

It seems conceivable that three types of uncertainty (state, effect, and response uncertainty) can be appropriate concepts for understanding environmental uncertainty, especially in very complex health care environment. Unlike the concept of domain or component of environment, the three types of uncertainty not only allow researchers to briefly represent environmental uncertainty, but also provide researchers with a unified framework for the next level of studies such as the effect of the fit on performance and risk management. Given that many studies remain in the alignment study between business strategy and IT strategy, the extension of alignment study to the basic level of environmental uncertainty can contribute to form a holistic view connecting from environment to strategy. Moreover, it seems that understanding interplay of influence among diverse components in the healthcare industry with respect to uncertainty will contribute to find ways to improve forecasting and mitigate risks in the healthcare industry.

## **Managerial Implications**

The findings of our study provide useful information to practitioners. First, the dominant state type of uncertainty in health care environment highlights the importance of environment scanning for managers. In such quite uncertain health care environment, executive information system to help information scanning will be helpful. Second, managers are able to get positive firm performance by focusing on efficient-oriented strategies such as cost savings and lowering overhead costs in the healthcare industry. Finally, managers need to watch internal resources as well as external environment for fully exploiting benefits in the unpredictable circumstance. Advanced technologies are not just innovation, but they are an enabler to create innovation through the utilization of internal resources such as physicians' knowledge and organizational culture.

## **Conclusion**

This study examines the relationship between the types of uncertainty and strategy, the impact of the fit between uncertainty and strategy on firm performance, and the effect of CEOs' balanced attention to firm performance as well as their scanning behaviors. We incorporate two concepts of uncertainty, complexity-change and three types of uncertainty (state, effect, and response uncertainty), into the proposed model. Also, we contribute information literature by sophisticating the concept of uncertainty, including internal environment, and considering the moderate effect of information systems in the proposed model. Our findings contribute to information literature on how the fit affects firm performance in the complex health care environment. Through our findings, we believe that researchers may increase knowledge about the nature of uncertainty of environment, and the role of uncertainty in a firm. At the same time, we believe that managers may have a benefit by introducing different types of information systems for different uncertainty. For instance, to handle state uncertainty, managers can use IS allowing to scanning wide sources of information. To handle effect uncertainty, IS focusing on business analytics and business intelligence will be helpful to find the cause-effect relations. Lastly, to handle response uncertainty IS focusing strategic information systems or handling real options analysis will be helpful.

Apart from our contributions to the information literature, we acknowledge the following limitations. First, our limited time span would not be substantial to generalize our findings. Our sample comes from a specific time at 2008. Because firm performance can change over the course of time, it seems plausible to use longitudinal analysis using multiple period samples. Next, although we use objective data, 10-k document in our study, the meaningful interpretation would be possible by considering qualitative data from survey. In summation, the extension and further development of this study will deepen our knowledge not only on understanding health care environment but also on the proper use of advanced information technologies in the healthcare industry.

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