Co-evolution between institutional environments and organizational change

The mediating effects of managers' uncertainty

Xiaojun Zhang
Institute of Leadership and Education Advanced Development (ILEAD), Xi'an Jiaotong-Liverpool University, Suzhou, China

Abstract

Purpose – The purpose of this paper is to interpret organizational change from a co-evolutionary perspective. It examines the co-evolution between institutional environments and organizational change with the mediating role of uncertainty as perceived by managers.

Design/methodology/approach – The author employed an inductive case study to explore how institutional environments interact with organizational change in a novel context: a Chinese state-owned enterprise.

Findings – The author developed a co-evolutionary model of organizational change that emphasizes the interaction between institutional-level factors and organizational-level change as bridged by top management perceptions of uncertainty. The model also illustrates the dynamics of organizational uncertainty and its effects on organizational change.

Practical implications – The study implies that uncertainty may not be an inevitable negative influence on organizational development, and tell managers how to manages the dynamics of uncertainty through two principles.

Originality/value – This study contributes to the organizational change literature by interpreting organizational change as the results of interaction between multi-level factors from institutional, organizational, and team levels. The author also expand the understanding of uncertainty from a dynamic perspective.

Keywords Case study, Organizational change, Co-evolutionary perspective, Managerial intentionality, Uncertainty dynamics

Paper type Case study

Introduction

The motor of organizational change is a central topic in the organizational research literature. Traditional Western theories of organizational change have been used to explore this question on various levels, including institutional constraints (Greenwood and Hinings, 1996; Scott, 2001), environment selection (Hannan and Freeman, 1979; Lewin *et al.*, 1999; Romanelli and Tushman, 1994), and organizational strategic choice (Child, 1997). In particular, recent studies in institutional analysis have looked at the relationship between organizational change and institutional-level transition (Lounsbury and Grumley, 2007; Smets *et al.*, 2012). They found that there is a mutual influence between organizational change and the external environment, which echoes the argument of the co-evolutionary perspective.

The co-evolutionary perspective interprets organizational change by emphasizing the interaction among factors at various levels, such as managerial intentionality from the individual organizations and selection from the macro environment (Lewin and

Journal of Organizational Change Management
Vol. 29 No. 3, 2016
pp. 381-403

0953-4814
DOI 10.1108/JOCM-12-2014-0218

Volberda, 1999). The limited existing research from the co-evolutionary perspective has focussed mainly on new organizational forms (Lewin *et al.*, 1999; Volberda and Lewin, 2003) and capabilities (Jacobides and Winter, 2005). However, there is little empirical research on how organizational change co-evolves with factors at various levels. We still know very little about how organizational change is shaped by external factors and, in return, how it shapes changes in the external environment, which may further influence organizational change.

This paper aims to address this problem by examining how a company changes through dynamic management of uncertainty. By interpreting uncertainty as the perception of managers concerning the external environment, we are able to link together the internal and external factors of organizations. Thus, uncertainty dynamics can illustrate how internal and external organizational factors interact with each other. The study of uncertainty in organizations has been a central theme for organizational scholars since the 1950s (Duncan, 1972; Lawrence and Lorsch, 1969; March and Simon, 1958; Milliken, 1987). However, the current literature offers mostly static models for classifying uncertainty at a point in time. We actually know little about whether the nature of uncertainty changes during different stages of an organization's development. Instead of applying the Western categorization of uncertainty at one point in time, this study examines whether the type of uncertainty differs at different stages of an organization's development and how uncertainty evolves dynamically, thus illustrating the transformation deriving from interaction between internal managerial cognition and the external environment.

We employed an inductive case study to explore the dynamics of organizational uncertainty and its effects on organizations in a novel context: a Chinese state-owned enterprise. Rapidly evolving institutional contexts and high organizational growth rates suggest that Chinese businesses present unique opportunities for studying the dynamics of uncertainty that organizations face. In contrast to existing research that has focussed on managerial responses to uncertainty without considering the effect of time, we employed HeXie management theory (hereafter referred to as HXMT), which identifies two basic logics that people adopt to deal with uncertainty (Xi *et al.*, 2006, 2010, 2012). We use these to investigate how Chinese managers deal with dynamic uncertainties over time.

We found that organizational change is the outcome of interaction between factors at various levels over time. Although many existing studies have explored the influence of these respective individual factors on organizational change, we still know little about how these factors interact, both with each other and in the mutual influence between them and organizational change. The results of this study indicate that there are close interactions and mutually beneficial relationships between the institutional environment, top management teams, and organizational change. We also found that managerial uncertainty has a mediating effect on the interaction between these factors at various levels. Specifically, the uncertainty is generated through the interaction between managerial intentionality and the institutional environment. We further discovered that the transformation of uncertainty may cause organizational change that is reflected by the creation of new core elements in the organization. In particular, when uncertainty transforms, the logic of creating core elements also shifts, and new organizational elements emerge.

Further, this paper improves the understanding of uncertainty dynamics and the dynamic effects of uncertainty on organizational change from a co-evolutionary perspective. The study contributes to management research because it addresses

uncertainty by exploring the dynamic evolving process of uncertainty in organizations and provides a rare account of the transformation of uncertainty over time. Previous studies have tended to focus on uncertainty as it occurs at a single point in time and on its typologies (e.g. Milliken, 1987).

Theoretical background

The motors of organizational change

Numerous studies have focussed on the motors of organizational change. Van de Ven and Poole (1995) concluded that the motors are quartered on various levels. In a single-unit level, the motors of change include organic growth based on the life-cycle theory, and purposeful cooperation based on the teleological theory. According to life-cycle theory, change is imminent as organizations have within them an underlying form, logic, or code that regulates the process of change and moves organizations from a given point of departure toward a subsequent end that is prefigured in the present state (Greiner, 1972; Quinn and Cameron, 1983). Teleological theory, however, considers organizations as purposeful aggregates constituted by members pursuing personnel goals, and views organizational development as a repetitive sequence of goal formulation, implementation, evaluation, and modification (Chakravarthy and Lorange, 1991).

At a multi-units level, competitive survival and conflict are considered as two motors of change (Van de Ven and Poole, 1995). Organizational evolution theory, which is analogical to biological evolution, explains change through a continuous cycle of variation, selection, and retention. Populations of organizational entities compete for scarce resources through variation, and the environment selects entities that best fit the resource base of an environmental niche; then, certain organizational forms are reserved (Hannan and Freeman, 1979). Dialectical theory, contending that conflict is a motor, assumes that organizations exist in a pluralistic world of colliding events, forces, or contradictory values that compete with each other for domination and control. Stability and change of organizations can be explained by the balance of power between these events of forces. Change occurs when these opposing values, forces, or events gain sufficient power to confront the status quo (Van de Ven and Poole, 1995).

Van de Ven and his colleagues contended that any explanation of specific phenomena in reality should combine these motors on different levels (Van de Ven and Poole, 1995). Nonetheless, current research on organizational change has focussed mainly on the influential factors from a specific level at one point in time (e.g. Zhou *et al.*, 2006). His study is an attempt to explore the mutual effects of motors from multiple levels on organizational change and, more important, to investigate the relationship between motors on different levels from a co-evolutionary perspective. We link these motors at different levels by examining uncertainty as dynamically perceived by managers.

To interpret the dynamic process of organizational change, we learned from studies on organizational core elements. Organizational change relates to the renewal of organizations with respect to technology, procedures, and products (Brown and Eisenhardt, 1997; Zhou *et al.*, 2006). Studies that examine organizational core elements offer holistic ways to view organizational change. This holistic method considers organizations to be systems composed of highly interdependent elements. Some of these elements are held as more critical to the development of organizations than others; thus, they are divided into core and elaborating elements. Core elements are defined according to the interactions that occur among them because they possess high interdependency with other current or future elements (Siggelkow, 2002). In other

words, "coreness means connectedness" (Hannan *et al.*, 1996, p. 506), as core elements possess greater amounts of connectedness than elaborating elements (Xi and Tang, 2004). This interaction-based perspective holds that core elements change over time and that the updating of core elements illustrates the process of organizational change. In this paper, we adopted this idea in order to observe organizational change by observing the creation of new core elements.

Organizational uncertainty and its management

Organizations are always faced with uncertainty. Research on organizational uncertainty has focussed primarily on two distinct, rather conflicting perspectives. The first perspective has considered uncertainty to be an objective phenomenon, focussing on the objective volatility of the organizational environment (Cyert and March, 1963; March and Simon, 1958; Miller *et al.*, 2002). The second perspective has emphasized the perceptual nature of uncertainty (Duncan, 1972; Lawrence and Lorsch, 1969; Milliken, 1987; Sawyer, 1993; Waldman *et al.*, 2001). The objective perspective considers that organizational uncertainty consists of facets of an organization's environment that are characterized by complexity and dynamics (Milliken, 1987). Organizational theorists employ the objective perspective of uncertainty as the central concept when they explain the relationship that exists between organizations and the environments in which they operate (Dill, 1958; Thompson, 1967).

The perceptual perspective adds to the concept of uncertainty by suggesting that environments influence decision making in organizations only if decision makers perceive that uncertainty exists (Milliken, 1987). The degree of organizational uncertainty depends on the quantity of information that decision makers can access and interpret about their environments, irrespective of the objective state of the environments. That is, the perceptual perspective considers uncertainty as the outcome of interaction between internal managerial cognition and external environment; this view is helpful for our research questions.

A significant amount of uncertainty research has also focussed on how organizations should cope with uncertainty. The basic assumption is that uncertainty has a negative impact on organizational development and that it should be reduced by means of various methods and strategies (Desarbo *et al.*, 2005; Mascarenhas, 1982). However, little research has investigated how organizations choose specific methods and strategies when facing uncertainty and why they adopt different methods when facing different kinds of uncertainties.

In conclusion, existing research has revealed that uncertainty is generated through the interaction between internal and external factors and that it may lead to organizational changing activities. Such research provides a prime opportunity for us to link internal managerial cognition, external environment, and organizational change. However, because scholars have heretofore discussed uncertainly mainly as it exists at one point in time, as noted previously, they have not concerned themselves with how and why this state transforms over time. This gap in the research limits our understanding of how the interaction between internal and external factors evolves over time. Therefore, we adopt the perceptual perspective in this study to examine uncertainty dynamics.

Uncertainty management from the perspective of HXMT

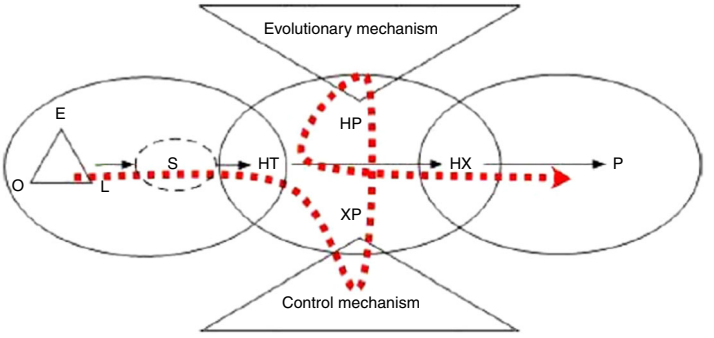
The problem with studying uncertainty dynamics is to find a theoretical model to link internal managerial cognition, the external environment, and organizational change.

HXMT provides a holistic framework for solving this problem (Figure 1). This theory points out that external environment and organizational conditions are critical for organizational managers in formulating strategy and directing development.

The main idea of HXMT. HXMT proposed two principles, the He and Xie principles (Xi *et al.*, 2010, 2012), which can interpret how organizations choose specific methods to cope with uncertainty. These principles consider the programmability of methods used to cope with uncertainty. The Xie principle can be adopted to cope with uncertainty that arises from technical systems (Stone and Fiorito, 1986), which are unrelated to people. The He principle can be adopted to deal with uncertainty caused by the behaviors and psychological activities of individuals who work in, for, and with organizations (e.g. Thau *et al.*, 2007).

On the one hand, organizations and environments comprise tightly coupled technical elements that are unrelated to human beings. These elements include techniques, structures, and information systems (Dayton, 2004; Pearson and Clair, 1998; Pearson and Mitroff, 1993). Prominent methods that deal with uncertainty caused by technical systems include strategic planning (e.g. Beckman *et al.*, 2004; Sutcliffe and Zaheer, 1998; Teplensky *et al.*, 1993), organizational design (e.g. Folta, 1998), optimal programming (e.g. Delage and Ye, 2010; Wilson, 1966), and governance structure and contract design related to agency theory; these all employ the Xie principle as well as the logic of rational design. The Xie principle is defined as the logic that emphasizes the use of established processes, regulations, and standards to reduce uncertainty. This principle aims to control and restrain uncertain factors stemming from materials, as well as individual behaviors caused by design and optimization methods and bureaucratic regulations (Xi *et al.*, 2010). The basic assumption of the Xie principle is that people are rational; therefore, they will behave obediently in relation to established regulatory frameworks.

On the other hand, organizational managers may also be affected by uncertainty that arises from the innumerable and diverse range of complex interactions that involve human beings. These include the cognitive limitations, subconscious behaviors, and development of socially shared meanings (Dayton, 2004; O'Connor, 1987; Schwartz, 1987) that occur because organizations are embedded into specific societies (Meyer and Lu, 2004). Moreover, uncertainty may increase because social systems interact with technical



Notes: L, leadership; O, organization; E, environment; S, strategy; HT, He-Xie theme; HX, He-Xie coupling; HP, He principle; XP, Xie principle; P, performance
Source: Xi *et al.* (2010)

Figure 1.
The theoretical framework of HeXie management theory

systems in various ways (Trist, 1981). The uncertainty related to social systems can be addressed with emergent methods developed according to the logic of the He principle.

The He principle is defined as the logic that emphasizes the establishment of positive atmospheres to induce individuals to behave in ways that contribute to organizational goals. The basic assumption of the He principle is that people are rationally bounded and that they possess subjective creativities. In other words, the He principle is an evolvement mechanism based on organizational members' initiative and self-determination. It advocates "[c]reating organizational culture, values, and beliefs by constructing necessary organizational circumstances, atmosphere or conditions and providing a platform for initiative and self-determination of organizational members" (Xi, *et al.*, 2012, p. 404). For example, Ouchi (1979) proposed a cultural mechanism that could not be intentionally managed (Ouchi and Wilkins, 1985) to reduce the uncertainty caused by individual behaviors. Social psychology studies have also argued that social and cultural factors peculiar to a specific organization, such as fairness and trust, are essential for managing the uncertainty caused by individuals (Thau *et al.*, 2007; Van den Bos *et al.*, 2007).

Because the He and Xie principles do not contradict each other, they can be employed simultaneously to address similar types of uncertainty, although their logics and functions differ. Therefore, HXMT proposes the use of the HeXie theme to decide which principle should be employed to address specific uncertainty. The HeXie theme is defined as follows:

> The HeXie Theme suggests which principle, He or Xie, should be selected to respond to management challenges. According to the HeXie Management Theory, the Xie Principle should be used when management challenges arise from technical factors. The He Principle is a better choice when management is challenged by social factors, such as uncertainty that is caused by individual behaviors […] [T]he selection of the Xie Principle or the He Principle is determined by the HeXie Theme […] HeXie Management Theory ensures that the discovery and identification of the HeXie Theme is the most important task for leaders in a given organization (Xi, *et al.*, 2012, p. 405).

The contribution of HXMT to uncertainty management. From the dynamic perspective, if uncertainty transforms over time, then the principle(s) and strategies used to cope with uncertainty may also change. This indicates that the impact of uncertainty on organizational change may be substantive. Although the strategies and methods used to cope with uncertainty have been explored at length in the extant literature, the changes that occur in these strategies and methods because of uncertainty transformation have hardly been investigated. HXMT provides the fundamental logic necessary to link uncertainty with the strategies for coping with it. Specifically, the He and Xie principles interpret the logic of methods employed to cope with uncertainty. The HeXie theme determines which principle should be used to address specific uncertainty. To examine the effects of uncertainty on organizational change, we considered strategies and methods to be the core elements that reflect organizational change. We investigated the relationships that exist among uncertainties, the HeXie theme, the He and Xie principles, and new core elements over time.

Methods

Research setting

In this study, we explored the interaction between institutional factors and organizational change by examining the dynamic of organizational uncertainty and

its effect on organizational change. Given the procedural nature of the study, we employed a case study approach to examine these processes and relationships (Eisenhardt, 1989; Yin, 1984). We chose an oil extraction factory, Xoil, as the subject of our examination. Xoil is one of many oil-extracting fields managed by a state-owned enterprise. This factory is solely responsible for oil extraction in the oil exploitation chain. Xoil is located in a main grain producing area in northwest China. It began to extract oil in 2003, after which it experienced a period of rapid development that continued until 2008. Since its establishment in 2003 Xoil was an excellent example for successful development in the state-owned enterprise and many peers visited and learned from Xoil in the following years.

We chose to study Xoil for the following reasons. First, given that only a limited amount of knowledge has been accumulated that addresses the dynamic of uncertainty and its effect on organizational change, it seemed appropriate to perform a single-case study focussed on the richness of the phenomena and to obtain relevant descriptions. We studied Xoil's development between 2003 and 2008 (i.e. Xoil's startup period). This provided an excellent research context because Xoil was confronted with a number of uncertainties during this period. Second, the Chinese energy industry is faced with many expectations related to the market, its relationship to the natural environment, and employee regulations. Managers in this industry must address the uncertainty that arises from the complex demands and expectations of these external constituencies. Moreover, because Xoil is an oil-extracting factory that is engaged in strenuous and dangerous work, Xoil's management must cope with uncertainty that arises within the organization by employing various strategies and methods. Third, because Xoil's leaders expressed great interest in our research project, they provided access to a wide range of managers and employees within the organization. They also provided a wealth of archival data that included organizational documents, news articles, and industry reports, thereby presenting us with a significant opportunity to triangulate our data using these different sources (Eisenhardt, 1989).

Data sources

Data were collected from three sources: archival documents, semi-structured interviews, and non-participant observations.

Archival documents. The research team identified 43 archival documents. These documents included annual reports (six), senior executives' external presentation notes (eight), junior managers' reports (seven), senior executives' internal presentation notes (2003-2008) (12), parent company documents (CNPC) (three), and news and survey reports (seven). These documents were used to identify the uncertainties perceived by managers and organizational core elements (prior to the interviews). They were also used to validate conclusions drawn from the interviews and to check for retrospective bias.

Interviews. The authors of this paper conducted 15 semi-structured interviews with 13 informants. One interview was conducted with one senior executive and two interviews with another senior executive. A panel interview was conducted with three department directors, and each director was also interviewed separately. Additional interviews were conducted with three members of the Xoil managerial staff and five operational workers. Interviews with informants drawn from different levels within the organization strengthened the study because it is highly likely that different types of employees would have different perspectives on organizational facts and events that might mitigate potential informant bias. All 15 in-depth interviews were conducted

face-to-face. Each interview lasted at least 1.5 hours, during which time the interviewers took notes. Semi-structured interview templates were used to guide the interview process.

Non-participant observations. In August 2008, the authors visited Xoil's factory and attended a strategic planning meeting. The authors visited most of Xoil's production field, monitoring center, and employee apartments. These field observations helped researchers gain a better understanding of factory events and environments. In total, 15 meeting reports and field notes were written and used as verification data.

Data analysis

The data were analyzed in four key steps. Different sources of data were triangulated to ensure consistency among them and to avoid possible bias (Table I). Only data that could be confirmed by all the three sources were adopted.

Step 1: understand the case. To gain a comprehensive understanding of Xoil, the research group visited the factory to observe the internal and external production environment. Because oil production processes are highly technical, researchers were offered voluminous technical documents to help them understand the processes involved in drawing oil from beneath the ground, separating impurities, transporting oil, transforming it into finished products, and avoiding pollution of the natural environment. These learning activities provided the research team with important contextual information (Miles and Huberman, 1994).

Step 2: analysis of archival data. Following the initial field observations, the first round of archival data analysis was conducted to identify the uncertainties perceived

Variables	Archival data	Interview data	Observation data
Uncertainty	Annual reports Reports of junior managers Presentation notes of senior executive External presentations of senior executive	Senior executives Department directors Managerial staff	Weekly meeting of the factory Dinners with senior executives
HeXie theme	Books Annual reports Documents from parent company Presentation notes of senior executive External presentations of senior executive	Senior executives Department directors Senior executive of parent company	Weekly meeting of the factory Dinners with senior executives
Core elements (HP and XP)	Books Annual reports News articles Reports of junior managers Documents from parent company Presentation notes of senior executive External presentations of senior executive	Managerial staff Senior executives Operational workers Department directors Senior executive of parent company	Tour of the factory Tour of the historical museum Weekly meeting of the factory Dinners with senior executives Tour of the employee apartment

Table I.
Triangulation of data

by Xoil's managers and the core elements that had emerged over time. The identification of uncertainty was based on Milliken's (1987) definition: uncertainty is an individual's perceived inability to predict something accurately. Three experts grouped the data into time-sequenced arrays and coded them, respectively by the use of an iterative, interpretive approach that required movement between data and literature. Several discussions were held to identify a chain of evidence and develop a coherent explanatory framework (Tsui-Auch and Moellering, 2010). Nine perceptions of managers' inability to predict something were identified as second-order data and finally, four uncertainties as theoretical dimensions were emerged in this inductive analyzing process. Table II illustrates how the four uncertainties were identified and the evidence of each kind of uncertainty.

The next process involved identifying newly created core elements according to methods the organization employed to cope with uncertainty over time. Identification was based on the definition of core elements from the interactive perspective. In other words, an element was considered a core element only if it "interact[ed] with many other current or future organizational elements" (Siggelkow, 2002, p. 127). The organizational system could be considered a series of networks comprising nodes (elements) and connecting edges (interactions). Thus, core elements can be found by counting the number of interactions between each element (Siggelkow, 2002). This paper employed two methods of centrality measures, including degree centrality (Freeman, 1979) and second-order degree (Siggelkow, 2002). The term "newly created" as used in the foregoing discussion refers to core elements appearing in one stage but not having appeared in prior stages. Newly created core elements were listed by eliminating reappearing elements.

After identifying institutional environments, managerial perceived uncertainties, and newly created core elements, we putted all of them into time-sequenced arrays and a pattern that links these factors together emerged. Specifically, the interaction between institutional and organizational factors was presented in the "the dynamic of uncertainty" section, and the interaction between organizational and team-level factors was presented in the "newly created core elements" section. To explain this pattern, we adopted the framework of HXMT. Therefore, the data analysis process is inductive in nature although an established theory was adopted in developing the theoretical model.

Step 3: analysis of interview data and observation notes. During the factory visit, we discovered that two middle-level managers who worked in the business administration department possessed high-level knowledge about managers' perceptions of uncertainties and the methods they used to cope with them. Initially, we interviewed these two managers, conducting a two-part interview and then discussing our coding results with them. During the first part of the interviews, the managers were asked to recall primary uncertainties the organization had encountered between 2003 and 2008 and to describe the methods employed to cope with these uncertainties. General questions that guided these interviews included: "From 2003 to the present, has Xoil encountered any unpredictable events and/or situations?"; and "How did Xoil cope with these events and/or situations?" During the second part of the interview, we asked the managers to express their understanding and offer suggestions. The main function of the interview was to complement archival data and to ensure that the data analysis was consistent with Xoil's reality. We also hoped to reduce researcher bias. For instance, because we interviewed senior managers whose presentations were included in our archival documents, we were able to explore their reasons for emphasizing technical

Uncertainty	Definition	Managers' perceptions	Typical quotations
Technology uncertainty	Inability of managers to predict outcomes and effects of technological search activities which are specific to the organization launching technological invent and innovation	Unpredictable outcomes and effects of low-osmotic oil extraction technology Unpredictable outcomes and effects of technology of distributed oil well layout Unpredictable outcomes and effects of the data collection technology of distributed oil well layout	We did not know whether we can breakthrough the low osmotic oil extraction technology and whether the technology can be profitably adopted (Director) The bad natural and social environment of Xoil made it much more difficult to predict whether we can successfully product oil here (Secretary of Xoil)
Ecology uncertainty	Impossible to predict the standard of natural environment protection and effects of it to organizations, and difficult to response to the requirements of environment	Not sure about specific requirements of the natural environment protection in residential area Not sure about how national laws and regulations on environment protection would change	The national standard of natural environment protection became higher and higher in recent years, we are difficult to assess the effects of this change on oil extraction and are hard to response to the change timely (A Vice Director of Xoil)
Society uncertainty	Inability of managers to predict the attitude of institutions and individuals in societies they embedded and further inability to react to emergent issues arising from incontrollable activities of other social actors	Managers did not know how local government could support the development of Xoil Oil in pipeline was frequently stolen by residents and the factory was difficult to prevent stealing activities. Managers of Xoil were unable to figure out appropriate reactions to this problem	We have no direct control power to society management and can not regulate the behavior of local residents, this make us hard to react to the stealing activities of local residents and we should always deal with emergent issues arising from stealing activities (A Vice Director of Xoil)
Employee uncertainty	Inability of managers to predict the behaviors of employees and to response to the uncontrollable employee behaviors to contribute to organizational goals	Managers felt difficult to control employees' work behaviors Managers were unable to predict whether its employees' behaviors can contribute to organizational goals	We are always establishing new organizational processes and regulations to constrain employees' behaviors, because these behaviors are so hard to predict and we hope to control them by clear structures (Manager of Human Resource Department)

Table II.
Four types of uncertainty Xoil encountered over time

problems during the first few years. We also explored the reasons for their later focus on the relationships formed with the local government. We asked these managers to provide a list of other individuals who might have insights into uncertainties faced by the organization and the strategies used to cope with these uncertainties.

Based on the provided list (although not exclusively), we then interviewed other managers. That interview followed the same process described above to ensure coherence and consistency across the data set. In addition, five operational workers also provided information about executives' behaviors and decisions. They offered their perspectives on the ways employees reacted to organizational elements such as structure, regulations, and culture. We then compared the information provided by the different interviewees and conducted additional follow-up interviews to sort out differences in interpretations (Gilbert, 2005). During this step, our observation data were simultaneously employed with interview data to verify our coding of archival data, and the interviewees confirmed all uncertainties and new core elements. The simultaneous use of real-time data and retrospective data ensured the validity of our analysis (Eisenhardt, 1989).

Step 4: analysis refinement. Following the completion of interviews, we verified the initial results by means of follow-up interviews. We conducted an informal discussion with a senior manager and the two middle-level managers mentioned above to validate our preliminary findings. Some perceptions of managers and their methods were further refined by this procedure. Finally, we facilitated a conversation with the senior manager to finalize lists and models. In light of the above-mentioned points, the research process matched Miles and Huberman's (1994) definition of an iterative process. Through triangulation of data sources and frequent interaction between researchers and informants, we improved the validity of the research findings.

Results

The dynamic of uncertainty

We identified 18 distinct organizational uncertainties that occurred over a six-year period. We classified them into four time-sequenced uncertainties: technical; ecological; societal; and employee (Table II).

Technical uncertainty. Xoil is located in the Erodes Basin, where the average oil permeability is 0.3 millidarcy (the average permeability of the world's oil wells is up to eight millidarcys). This level was so low that foreign experts considered the oil field "impossible to develop." However, because of the nation's strategic interest in oil field construction, the parent company decided to explore the Xoil oil field, and it began production in 2002. Faced with this "impossible mission," Xoil's managers "concentrated Xoil's energy" to solve the "world technological problem" of low-osmotic oil extraction. As they focussed their attention on the challenge of technological innovation, they remained unsure "whether (or not) they could succeed." They were unable to predict "the future of Xoil." A worker on the technical innovation team remembered:

> When we began to perform research on the effective extraction of low osmotic oil, we changed traditional extraction methods and processes and performed experiments thousands of times. Our managers paid a great deal of attention to our work and always inquired about the possibility of inventing new technologies.

New problems emerged once they had solved the technical problems. The underground oil was dispersed over a large area, so it "was hard to collect profitably" by traditional pipeline design methods. The output per oil well was "quite low," although the length of pipeline per oil well was "quite high." Additionally, it was difficult to collect productive

data from each oil well in a "timely" and "economical" manner because the oil was widely dispersed. Thus, Xoil's future remained uncertain. It appeared that new pipeline design methods were required. During the search for new methods, Xoil's managers felt exhausted by the uncertain outcome of their efforts and the related stress. One manager said:

> The dispersion of Xoil's oil made it much more difficult to predict whether we could successfully extract oil here. Although we held many meetings to discuss the future of Xoil, we were always uncertain about the outcome of our technological search activities and the profitability of the new technology.

During our careful analysis of Xoil, we discovered that once the factory began to explore low-osmotic oil extraction technologies and distributed oil well technologies, managers began to perceive significant amounts of uncertainty factors, such as unpredictable outcomes of technological search behaviors and doubts about the profitability of the new technology. Fleming (2001) suggested that uncertainty exists within both technological invention and innovation processes, and we observed this during our analysis of Xoil. Hence, we define technical uncertainty as managers' inability to predict the outcomes and effects of technological search activities.

Ecological uncertainty. In recent years, natural environmental protection has become one of the most important issues faced by companies across the globe. In particular, it is an extremely important issue for companies that operate in the energy field. Xoil encountered this issue at the very beginning of its intention to increase production. First, oil extraction damages the farmland on which is occurs, which is an already precious resource in China. Second, oil extraction produces significant amounts of effluent, exhaust gas, and waste materials that can harm soil, water, and air. The local residents vividly described an oil well as a "black beam unit, black device, or black place." These characteristics of oil extraction were obviously a negative factor in local economic development and residents' lives. Factory officials were unsure about the specific requirements for the natural environmental protection needed for this agricultural area, nor were they sure about the results of their own natural environmental protection solutions.

Because China's national government has begun to pay much greater attention to sustainability and environmental protection, Xoil's managers were unable to forecast "how national laws and regulations on environmental protection would change, and what effect these changes would have on the factory." China's development has caused rapid changes to the policy framework, including changes in the sphere of environmental protection. New regulations have been promulgated on a regular basis (e.g. The State Council of China, 1989, 2002a, b). These unpredictable conditions constitute the ecological uncertainty.

Societal uncertainty. Because it is affiliated with a state-owned enterprise, Xoil is directly controlled by its parent organization. However, Xoil is also constrained by the local government with respect to product security, farmland occupation approval, natural environmental protection standards, and contract-related issues. Additionally, Xoil and the local government have not entered into a formal administrative relationship. Local government procedures are time-consuming. They involve lengthy consultations as well as examination and approval processes upon which Xoil greatly depends to continue its oil extraction operations. Therefore, Xoil's managers have always been immersed in uncertainties relating to local government approval and

bureaucratic procedures that cloud the extent to which the local government could support Xoil's development.

Local residents' attitudes are an important source of social uncertainty for Xoil's managers. Pipe laying was distributed over a wide geographic area populated by many residents, who frequently stole the oil in the pipeline. Thus, the factory struggled to prevent oil theft by local residents. Xoil's managers were unable to decide on appropriate reactions to this problem. One manager complained:

> We cannot control society directly and cannot regulate the behavior of local residents. This makes it difficult for us to react to the stealing activities of local residents. We should always deal with emergent issues that arise from stealing activities.

As can be seen from this case, Xoil was compelled to interact with various institutions and individuals in the local society in which it was embedded. The attitudes and behaviors of these institutions and individuals were difficult to predict. It was also very difficult for Xoil to react to new regulations and demands related to sustainable development. We define societal uncertainty as managers' inability to predict the attitudes of institutions and individuals in the immediate environment in which they operate toward the organization's development.

Employee uncertainty. It is critical that managers encourage individuals to contribute to the achievement of organizational goals. This was a very important task for Xoil when it planned to stabilize production at a high level. However, it was a difficult task to achieve because of the work environment and because of the number of unpleasant jobs. First, respondents described oil extraction work as a tough job that was "dirty," "tiring," and sometimes "dangerous" because of contaminants that were harmful to health and because of conflicts that arose with local residents who were stealing oil from the pipeline network. This context complicated jobs and impeded management's ability to ensure that employees remained committed to the realization of agreed-upon organizational goals. Second, because Xoil's oil wells were distributed in outlying areas, supervision of employee conduct and compliance with organizational regulations were impossible to guarantee. Furthermore, it was difficult to guide employees' behaviors during unpredictable changes and events. Finally, for a technology-based factory, technological innovation is one of several critical tasks. However, it was "impossible" to guide researchers' innovative behavior by structure, regulations, and processes. These three characteristics made it difficult for managers to control employees' work behaviors and challenged Xoil's management to remain confident that employees' behaviors would contribute to organizational goals. Therefore, we define employee uncertainty as managers' inability to predict employees' behaviors and to respond effectively when employee behavior negatively affects the firm's objectives and goals.

In conclusion, we found that three factors were critical in the transformation of organizational uncertainties during Xoil's six-year history. First, both managers' intentionality and institutional environmental were important and inevitable for the emergence and development of uncertainty. For instance: the initial managerial intention to put Xoil into production combined with the character of its oil distribution led to technical uncertainty; the interaction between Xoil's requirement to increase production and obstructions that developed from the natural and social environment was the major contributor to the ecological and social uncertainties; and the combination between Xoil's requirement to stabilize production and tough conditions that affected employees' work and lives was the prerequisite for employee uncertainty.

Second, managers' cognitive perceptions were a critical factor in the creation of organizational uncertainty. Although the majority of the institutional environments existed all of the time between 2003 and 2008, managers' changing awareness of and emphasis on these factors caused changes in their influence on the organization as well. For example, in 2003, Xoil's director focussed on low-osmotic oil extraction technology, despite the presence of social and employee problems at that time. In the 2004 annual report, the director emphasized that the factory should perform a timely assessment of the effects of increasing national standards for the natural environmental protection passed in recent years. However, he alluded only briefly to employee-related conditions. Managers did not feel pressured by employees' attitudes toward factory development until 2006. Thus, shifts in managers' cognition also led to the transformation of uncertainty.

Newly created core elements

Once we established the newly created core elements for each year, we discovered that these core elements were distributed into three clusters, which were highly interdependent. We asked our interviewees why these three elements were so closely connected to each other. They responded that these elements were actually the factory's periodic main tasks: technological innovation (2003.1-2005.6), environmental friendliness (2005.7-2006.12), and care for employees (2007.1-2008.12). We coded them as the HeXie theme and divided the six-year period into three stages. The uncertainties, HeXie theme, and newly created core elements for each stage are illustrated in Table III.

Stage 1. Managers perceived that the main type of uncertainty in this stage was technical uncertainty. By way of response, managers established technical innovation as the crucial task to be achieved during the initial two and one-half years. As indicated by the data, this core element was connected with all other newly created core elements during this stage, verifying the senior executives' interpretation that all work performed during this period was based on this theme.

With the exception of technical innovation, we identified eight newly created core elements during this stage. These included six technologies that were based on the Xie principle, the adoption of logic to reduce uncertainty by using efficacy in timely problem-solving, rapid optimization of solutions, and enhancement of existing processes and methods. For example, the oil prospection project that launched oil exploitation and oil prospection simultaneously provided significant time-savings in the low-osmotic oil extraction process. In addition, the geographical distribution of oil wells underground was redesigned based on the characteristics of low-osmotic oil. This change effectively reduced the uncertainty derived from technology. Second, the oil exploitation project reduced technical uncertainty by optimizing stream guidance pressing, introducing new chemical-engineering techniques, and simultaneously improving reliability while reducing repair turnaround times for oil wells by parameter optimization. Third, a ground construction project introduced new technologies to address issues related to oil well distribution and robotic control. Two newly created core elements were developed based on the He principle: innovation of culture and motivational mechanism, both of which were created to encourage initiative and inspire employees' innovative behaviors.

Stage 2. As Xoil continued to develop, uncertainty was transformed from technical uncertainty to ecological and societal. To address ecological uncertainty, the HeXie theme shifted into environmental friendliness, and the Xie principle became the

Stage	Uncertainty				Organizational change	
	Internal-external contradiction	Managerial cognition	Prominent uncertainty	HeXie theme	New core elements created based on Xie principle	New core elements created based on He principle
Stage 1	Low oil permeability Deeply buried Low economic benefit No technology for mining this kind of oil Strategy: put into production	Managers had no idea on how to economically mine Xiol	Technical uncertainty	Technical innovation	Oil storage project Oil main project Ground distribution project Information technology Innovating rules Hierarchical-level reduction	Innovating culture Motivating mechanism
Stage 2	Oil pollute environment Occupation of farmland Theft of local residents Disregard of local government Strategy: increase production	Managers had large pressure to build relationship with natural and social environment	Ecology uncertainty Society uncertainty	Environmental friendly	Environment protect techniques HSE system Process outsourcing	Environment protect culture Training Benefit-sharing mechanism Cooperation of organization and local Corporate social responsibility
Stage 3	Tough work and life site Dispersive oil well Tedious and hard job Lack of motivation Strategy: stabilize production	Managers felt impotent to control and predict employee's behaviors	Employee uncertainty	Care for employees	Workplace beautification Department boundary elimination	Value sharing Ability enhancement Organization vision Employee welfare Career management Relieve guard Training

Table III. Uncertainty and principles in each stage

dominant logic in dealing with ecological uncertainty. Because of the increasing importance of natural environmental protection, Xoil first established two specific institutions, the Health, Security, and Environment Committee (HSE) and the Monitoring Department, to ensure that environmental issues were seriously considered. These institutions held regular meetings to discuss and address environmental issues

encountered and to announce the environmental protection conditions for different processes. Second, waste materials, especially the discharge of air pollutants, were dramatically reduced and controlled by employing new recycling technologies. These technologies included innovative practices for the transportation and splitting of waste mixtures comprising oil, water, and gas. Critical innovation involved the rescheduling of times to split mixtures and the addition of new processes for waste material recycling. Finally, environmental protection standards and regulations specific to the whole oil extraction process were established, ranging from initial oil exploration to treatment of resulting waste materials. These standards formalized the requirements for air pollutant emission levels during each production process and the adoption of new technologies aimed at the improvement of environmental protection. Ultimately, ecological uncertainty can also be addressed by the redesign of organizational structures and processes, the institution of clear standards and regulations, and optimization of technological parameters. The only element based on the He principle was construction of an environmental protection culture. This aimed to provide a positive atmosphere to encourage protection of the natural environment.

To cope with societal uncertainty, Xoil's managers first constructed a benefit-sharing mechanism with the local government by increasing the taxes remitted to the local tax bureau. This mechanism "enhanced the positivity of local government to advance various approval processes." It encouraged the local government to support Xoil's development. Second, Xoil outsourced many projects that were unrelated to core technologies to local firms in order to assist local businesses in their development and to help the government solve employment problems. This approach encouraged the local government and other organizations to pay greater attention to Xoil's development. Third, to encourage positive changes in local residents' attitudes, Xoil frequently supported local poor students and families, and helped local residents to build fundamental facilities, such as roads and places to obtain clean drinking water. Xoil also joined the government to fight together against drought. These activities raised local government and resident awareness that they realized they could "benefit from Xoil's development." This program, which encouraged positive engagement with the local community and local authorities, exerted a transformative impact on local attitudes toward Xoil and resulted in the provision of continuous support for Xoil's development. Xoil's managers no longer needed to worry about the impact of negative behaviors from the local government and residents that might impede successful achievement of organizational objectives. Although Xoil could not directly control outside actors' activities with design and optimization methods, the company could and did employ indirect methods to induce positivity and initiative in outside actors. Ultimately, it reduced uncertainty in the society.

Stage 3. When managers perceived that employee uncertainty had become dominant, they transformed their HeXie theme into care for employees. The first element Xoil created to address employee uncertainty involved promoting employees' capabilities so they could work independently when managers were unable to provide direct supervision and monitoring of their activities. Specific elements included training, learning from excellent experiences, and field teaching by demonstration. Second, managers formulated the vision and mission of the factory and widely shared this vision with employees by implementing a program designed to improve internal communications. Because of these activities, employees became "cognizant of their attitude to society and the factory" and "devoted themselves to their detailed work."

Xoil developed a type of organizational culture that advocated "hard work" and "tolerance of hardships." This culture improved the employees' motivational disposition to work hard even during "tough" working conditions. Motivational mechanisms, such as a performance wage system, were also well designed to advance employees' work intentions and encourage them to behave in ways that would contribute to factory goals. Third, employees' work conditions were continuously improved by the institution of initiatives to reduce hierarchical levels with the express aim of promoting employees' "freedom." Similarly, the establishment of innovation rules prevented and excluded "managerial intervention" and interference with employees' innovative behaviors related to work improvements. Finally, Xoil cared for employees' lives. Xoil built a very beautiful recreation room and bought significant amounts of sport equipment specifically for employee use. These measures increased employees' trust in Xoil. They believed "it is a company I want to stay with and contribute to." These elements indicate that the He principle was the prominent logic employed under the HeXie theme during this stage.

The dynamic effect of uncertainty on organizational change

The data indicated that managers' perceptions of uncertainty serve as predictors of organizational change. When managers of the organization perceived uncertainties during a specific period, they tended to define critical organizational tasks to cope with these uncertainties. Then, the whole organization created new elements to implement the task established. This process involving the creation of new elements is, by nature, the process of organizational change. Xoil's development journey between 2003 and 2008 illustrates the impact of uncertainty on the choice of principle used to create elements during organizational change based on the mediating role of the HeXie theme (see Figure 2).

In addition, Xoil's development also indicates that because of the distinct formative sources and perceptions of the above-noted four types of uncertainty, the crucial task of the factory was transformed. As a result, the logics employed to implement the HeXie theme also shifted. As can be seen in Table III, technical uncertainty was prominent

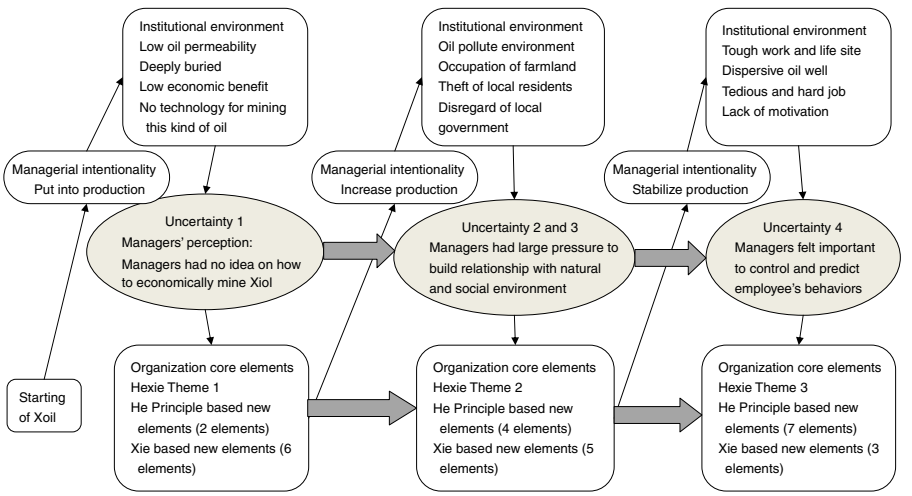


Figure 2.
The uncertainty dynamics and emergent organizational change from a co-evolutionary perspective

during Stage 1. Most of the elements created to cope with this uncertainty were based on the Xie principle, indicating that optimization of the productive processes and redesign of organizational structures can effectively reduce the uncertainties derived from technology and ecology. For example, changing the oil extraction process, establishing the HSE institution, and introducing new environmental protection standards were the typical methods employed at the beginning of the process. During Stage 2, ecological and societal uncertainties were the main uncertainty types perceived by Xoil management. These perceptions resulted in the simultaneous adoption of the Xie and He principles.

When employee uncertainty became prominent during Stage 3, the He principle was the dominant logic employed to address it. Because of managers' rationality in their decisions to regulate behaviors and because of subordinates' subjective creativity at work, it may be impossible to use rational design methods to control individuals' behaviors. Therefore, rather than trying to avoid uncertainty, Xoil's management attempted to benefit from employees' and social actors' uncertainties in hope of contributing to the achievement of organizational goals. Management did not, for example, design clear processes and structures for controlling either local government/resident or employee behaviors. Rather, they established benefit-sharing mechanisms with the local government and supported the livelihoods and occupations of local residents. In addition, Xoil's managers promoted employees' capabilities and intentions as a way to guide their behaviors.

Discussion

Through an examination of the ways that uncertainty in a Chinese SOE-affiliated factory transformed and influenced organizational change over time, we have developed two sets of theoretical contributions in this study, along with useful implications for managerial practice. Theoretically, our findings contribute to the organizational change literature by interpreting organizational change from a co-evolutionary perspective. We also contribute to the organizational uncertainty literature by expanding our understanding of uncertainty from a dynamic perspective.

First, with regard to the co-evolutionary perspective on organizational change, we clarified the motor, time, and direction of an organization's change by examining interactions between factors at institutional, organizational, and team levels. We discovered that manager perception of uncertainties may affect the HeXie theme, in turn impelling organizations to create new elements based on the He and Xie principles. The use of a specific principle, which is dependent on the HeXie theme, indicates the direction of change. These results imply that uncertainty would be a motor of organizational change and that the timing and direction of changes driven by uncertainty depend on the HeXie theme that emerged according to the managers' cognition. We further found that the transformation of organizational uncertainty starts with the renewal of managerial intentionality that is caused by organizational change stemming from response to the existing uncertainty, and that new uncertainty emerges when managers cannot get information related to the new intentionality. This finding demonstrates that uncertainty is the outcome of interaction between the internal and external factors emphasized in co-evolutionary theory. Therefore, we interpreted organizational change as the mutual influence of institutional environment, the cognition of the top management team, and past organizational change.

Moreover, extant literature on organizational change has proposed that organizational goals, competitive survival, and conflict are the motors of organizational change (Van de Ven and Poole, 1995). Change has been depicted as a process that involves movement from a given point of departure toward a subsequent end, which is prefigured in the present state (Greiner, 1972; Quinn and Cameron, 1983). In contrast, our study proposes an emergent process of individual organizational change wherein no prior plan for change exists, and no deliberate force promotes change. Change occurs when the organization is compelled to cope with uncertainty. Although uncertainty reflects lack of information about the environment, it occurs only when managers intend to get specific information from the environment.

Finally, this study increases the understanding of organizational uncertainty. Previous studies tended to examine uncertainty from a static perspective. They were reluctant to establish consistency on the objective and subjective nature of organizational uncertainty (Milliken, 1987). Because this study focusses on the joint impact of managerial intentionality, objective environmental conditions, and managers' perceptions of the transformation of uncertainty, it highlights the importance of both objective and subjective understanding of uncertainty in relation to previous studies (e.g. Agle *et al.*, 2006; Waldman *et al.*, 2001). Uncertainty in organizations emerges and affects organizational development only when managers intend to search for specific information from the environment, having perceived a lack of their information. That is, uncertainty dynamics should be interpreted through a co-evolutionary view that combines both internal managerial intentionality and perception, and external environmental conditions.

Limitations and future research

This study contains several limitations that indicate possible future research directions. First, our findings are based on a single-case study of a Chinese SOE-affiliated factory. Further investigations of other organizations with varied ownership, different industries, and organizations in other countries should be launched to generalize these findings. Second, the relationship between the He principle and the Xie principle, a fruitful research topic, was not explored in this study. Although the HeXie theme can determine the choice of principle, these two principles may also interact with each other when they are adopted under a specific HeXie theme. The interaction between these principles is a vital aspect of organizational change. It deserves further exploration to gain a better understanding of the impact of uncertainty on organizational change. Finally, interview data were collected during the research. Thus, retrospective bias may have occurred. However, we do not believe a significant problem exists because we relied primarily on archival data to explore our questions. We used mainly interview data for verification.

Managerial implications

Two implications were derived that apply to practical managers. First, our study implies that uncertainty may not be an inevitable negative influence on organizational development. Therefore, managers may not exert their best efforts to reduce the possible influences of uncertainty on their organizations. Alternatively, they can employ the dynamic effect of uncertainty on organizational change to manage and control change as it occurs in their organizations. In addition, we recommend two types of principles managers can employ to cope with the uncertainties that arise from

different sources, as well as to manage the change process in organizations. Specifically, managers can employ the He principle to address uncertainties that arise from people's behaviors. Managers can employ the Xie principle for addressing uncertainties that arise from technical systems unrelated to people's behaviors.

Conclusion

This paper, an inductive case study of a Chinese SOE-affiliated oil extraction factory, has focussed on how organizational change happens through the interaction of institutional and managerial factors. The question is explored by examining the dynamic of uncertainty and its effect on organizational change. Our results show a co-evolutionary model of organizational change with the mediating role of uncertainty. We argue that uncertainty may promote organizational change based on the mediating role of the HeXie theme that determines the time and principles for the creation of new organizational elements. This result should encourage scholars and practitioners to manage and use uncertainty rather than solely attempting to reduce it. In addition, we also provide a dynamic model of manager's perceptions of uncertainty.

References

Bechman, C.M., Haunschild, P.R. and Phillips, D.J. (2004), "Friends or strangers? Firm-specific uncertainty, market uncertainty, and network partner selection", *Organization Science*, Vol. 15 No. 3, pp. 259-275.

Brown, S.L. and Eisenhardt, K.M. (1997), "The art of continuous change: linking complexity theory and time-paced evolution in relentlessly shifting an organization", *Administrative Science Quarterly*, Vol. 42 No. 1, pp. 1-34.

Chakravarthy, B.S. and Lorange, P. (1991), *Managing the Strategy Process*, Englewood Cliffs, Prentice Hall, NJ.

Child, J. (1997), "Strategic choice in the analysis of action, structure, organizations and environment: retrospect and prospect", *Organization Studies*, Vol. 18 No. 1, pp. 43-76.

Cyert, R.M. and March, J.G. (1963), *A Behavioral Theory of the Firm*, Prentice-Hall, Englewood Cliffs, NJ.

Dayton, B.W. (2004), "Managing crises in the twenty-first century", *International Studies Review*, Vol. 6 No. 1, pp. 165-194.

Delage, E. and Ye, Y. (2010), "Distributionally robust optimization under moment uncertainty with application to data-driven problems", *Operations Research*, Vol. 58 No. 3, pp. 595-612.

Desarbo, W.S., Benedetto, C.D., Song, M. and Sinha, I. (2005), "Revisiting the miles and snow strategic framework: uncovering interrelationships between strategic types, capabilities, environmental uncertainty, and firm performance", *Strategic Management Journal*, Vol. 26 No. 1, pp. 47-74.

Dill, W. (1958), "Environment as an influence on managerial autonomy", *Administrative Science Quarterly*, Vol. 2 No. 4, pp. 409-443.

Duncan, R.B. (1972), "Characteristics of organizational environments and perceived environmental uncertainty", *Administrative Science Quarterly*, Vol. 17, pp. 313-327.

Eisenhardt, K.M. (1989), "Building theories from case study research", *Academy of Management Review*, Vol. 14 No. 4, pp. 532-550.

Fleming, L. (2001), "Recombinant uncertainty in technological search", *Management Science*, Vol. 47 No. 1, pp. 117-132.

Folta, T.B. (1998), "Governance and uncertainty: the trade-off between administrative control and commitment", *Strategic Management Journal*, Vol. 19 No. 11, pp. 1007-1028.

Freeman, L.C. (1979), "Centrality in social networks: a conceptual clarification", *Social Networks*, Vol. 1 No. 3, pp. 215-239.

Gilbert, C.G. (2005), "Unbundling the structure of inertia: resource versus routine rigidity", *Academy of Management Journal*, Vol. 48 No. 5, pp. 741-763.

Greenwood, R. and Hinings, C.R. (1996), "Understanding radical organizational change: bringing together the old and the new Institutionalism", *Academy of Management Review*, Vol. 21 No. 4, pp. 1022-1054.

Greiner, L. (1972), "Evolution and revolution as organizations grow", *Harvard Business Review*, Vol. 50 No. 4, pp. 37-46.

Hannan, M.T. and Freeman, J. (1979), "The population ecology of an organization", *American Journal of Sociology*, Vol. 82 No. 5, pp. 929-964.

Hannan, M.T., Burton, M.D. and Baron, J.N. (1996), "Inertia and change in the early years: employment relations in young, high-technology firms", *Industrial and Corporate Change*, Vol. 5 No. 2, pp. 503-536.

Jacobides, M.J. and Winter, S.G. (2005), "The co-evolution of capabilities and transaction costs: explaining the institutional structure of production", *Strategic Management Journal*, Vol. 26 No. 5, pp. 395-413.

Lewin, A.Y. and Volberda, H.W. (1999), "Prolegomena on coevolution: a framework for research on strategy and new organizational forms", *Organization Science*, Vol. 10 No. 5, pp. 519-534.

Lewin, A.Y., Long, C.P. and Carroll, T.N. (1999), "The co-evolution of new organizational forms", *Organization Science*, Vol. 10 No. 5, pp. 535-550.

Lounsbury, M. and Grumley, E.T. (2007), "New practice creation: an institutional perspective on innovation", *Organization Studies*, Vol. 28 No. 7, pp. 993-1012.

March, J.G. and Simon, H.A. (1958), *Organizations*, Wiley, New York, NY.

Mascarenhas, B. (1982), "Coping with uncertainty in international business", *Journal of International Business Studies*, Vol. 13 No. 2, pp. 87-98.

Meyer, M.W. and Lu, X.H. (2004), "Managing indefinite boundaries: the strategy and structure of a Chinese business firm", *Management and Organization Review*, Vol. 1 No. 1, pp. 57-86.

Miles, M.B. and Huberman, M.A. (1994), *Qualitative Data Analysis*, 2nd ed., Sage Publications, Thousand Oaks, CA.

Miller, J., Wiseman, R.M. and Gomez-Mejia, L.R. (2002), "The fit between CEO compensation design and firm risk", *Academy of Management Journal*, Vol. 45 No. 4, pp. 745-756.

Milliken, F.J. (1987), "Three types of perceived uncertainty about the environment: state, effect, and response uncertainty", *Academy of Management Review*, Vol. 12 No. 1, pp. 133-143.

O'Connor, J. (1987), *The Meaning of Crisis*, Basil Blackwell, New York, NY.

Ouchi, W.G. (1979), "A conceptual framework for the design of organizational control mechanisms", *Management Science*, Vol. 25 No. 9, pp. 833-848.

Ouchi, W.G. and Wilkins, A.L. (1985), "Organizational culture", *Annual Review of Sociology*, Vol. 11 No. 3, pp. 457-483.

Pearson, C.M. and Clair, J.A. (1998), "Reframing crisis management", *Academy of Management Review*, Vol. 23 No. 1, pp. 59-76.

Pearson, C.M. and Mitroff, I.I. (1993), "From crisis prone to crisis prepared: a framework for crisis management", *Academy of Management Executive*, Vol. 7 No. 1, pp. 48-59.

Quinn, R.E. and Cameron, K. (1983), "Organizational life cycles and shifting criteria of effectiveness: some preliminary evidence", *Management Science*, Vol. 29 No. 1, pp. 33-51.

Romanelli, E. and Tushman, M.L. (1994), "Organizational transformation as punctuated equilibrium: an empirical test", *Academy of Management Journal*, Vol. 37 No. 5, pp. 1141-1166.

Sawyerr, O.O. (1993), "Environmental uncertainty and environmental scanning activities of Nigerian manufacturing executives: a comparative analysis", *Strategic Management Journal*, Vol. 14 No. 4, pp. 287-299.

Schwartz, H.S. (1987), "On the psychodynamics of organizational disaster: the case of the space shuttle Challenger", *Columbia Journal of World Business*, Vol. 22 No. 1, pp. 59-68.

Scott, W.R. (2001), *Institutions and Organizations*, 2nd ed., Sage, Los Angeles, CA.

Siggelkow, N. (2002), "Evolution toward fit", *Administrative Science Quarterly*, Vol. 47 No. 1, pp. 125-159.

Smets, M., Morris, T. and Greenwood, R. (2012), "From practice to filed: a multilevel model of practice-driven institutional change", *Academy of Management Journal*, Vol. 55 No. 4, pp. 877-904.

Stone, T.H. and Fiorito, J. (1986), "A perceived uncertainty model of human resource forecasting technique use", *Academy of Management Review*, Vol. 11 No. 3, pp. 635-642.

Sutcliffe, K.M. and Zaheer, A. (1998), "Uncertainty in the transaction environment: an empirical test", *Strategic Management Journal*, Vol. 19 No. 1, pp. 1-23.

Teplensky, J.D., Kimberly, J.D., Hillman, A.L. and Schwartz, J.S. (1993), "Scope, timing and strategic adjustment in emerging markets: manufacture strategies and the case of MRI", *Strategic Management Journal*, Vol. 14 No. 7, pp. 505-527.

Thau, S., Aquino, K. and Wittek, R. (2007), "An extension of uncertainty management theory to the self: the relationship between justice, social comparison orientation, and antisocial work behaviors", *Journal of Applied Psychology*, Vol. 92 No. 1, pp. 250-258.

The State Council of China (1989), The Environmental Protection Law.

The State Council of China (2002a), The Environment Impact Assessment Law.

The Stage Council of China (2002b), The Land Management Law.

Thompson, J.D. (1967), *Organizations in Action*, McGraw-Hill, New York, NY.

Trist, E. (1981), "The evolution of socio-technical systems", in Van de Ven, A.H. and Joyce, W.F. (Eds), *Perspectives on Organization Design and Behavior*, Wiley, New York, NY, pp. 68-103.

Tsui-Auch, L.S. and Moellering, G. (2010), "Wary managers: unfavorable environments, perceived vulnerability and the development of trust in foreign enterprises in China", *Journal of International Business Studies*, Vol. 41 No. 6, pp. 1056-1073.

Van de Bos, K., Euwema, M.C., Poortvliet, P.M. and Maas, M. (2007), "Uncertainty management and social issues: uncertainty as an important determinant of reactions to socially deviating people", *Journal of Applied Social Psychology*, Vol. 37 No. 8, pp. 1726-1756.

Van de Ven, A.H. and Poole, M.S. (1995), "Explaining development and change in organizations", *Academy of Management Review*, Vol. 20 No. 3, pp. 510-540.

Volberda, H.W. and Lewin, A.Y. (2003), "Co-evolutionary dynamics within and between firms: from evolution to co-evolution", *Journal of Management Studies*, Vol. 40 No. 8, pp. 2111-2136.

Waldman, D.A., Ramirez, G.G., House, R.J. and Puranam, P. (2001), "Dose leadership matter? CEO leadership attributes and profitability under conditions of perceived environmental uncertainty", *Academy of Management Journal*, Vol. 44 No. 1, pp. 134-143.

Wilson, R. (1966), "On programming under uncertainty", *Operations Research*, Vol. 14 No. 4, pp. 652-657.

Xi, Y.M. and Tang, F.C. (2004), "Multiplex multi-core pattern of network organizations: an exploratory study", *Computational and Mathematical Organization Theory*, Vol. 10 No. 2, pp. 179-195.

Xi, Y.M., Cao, X.W. and Xiangli, L.X. (2010), "A Chinese view on the rebuilding the integrity of management research", *Chinese Management Studies*, Vol. 4 No. 3, pp. 197-211.

Xi, Y.M., Han, W. and Ge, J. (2006), *Research on the HeXie Management Theory*, Xi'an Jiaotong University Press (in Chinese), Shaanxi.

Xi, Y.M., Zhang, X.J. and Ge, J. (2012), "Replying to management challenges: integrating oriental and occidental wisdom by HeXie management theory", *Chinese Management Studies*, Vol. 6 No. 3, pp. 395-412.

Yin, R.K. (1984), *Case Study Research: Design and Methods*, Sage, Los Angeles, CA.

Zhou, K., Tse, D. and Li, J. (2006), "Organizational changes in emerging economies: drivers and consequences", *Journal of International Business Studies*, Vol. 37 No. 2, pp. 248-263.

Further reading

Hannan, M.T. and Freeman, J. (1984), "Structural inertia and organizational change", *American Sociological Review*, Vol. 49 No. 2, pp. 149-164.

Lawrence, P.R. and Lorsch, J.W. (1969), *Organization and Environment*, Irwin, Homewood, IL.

About the author

Xiaojun Zhang is currently a Lecturer and Deputy Director at the Institute for Leadership and Education Advanced Development (ILEAD) of Xi'an Jiaotong-Liverpool University. His research areas include organizational change, indigenous management theory, and leadership theory. Xiaojun Zhang can be contacted at: xiaojun.zhang@xjtlu.edu.cn