

## Article

# Innovation Resilience: A New Approach for Managing Uncertainties Concerned with Sustainable Innovation

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**Abstract:** Sustainable innovation is more complex than conventional, market-driven innovation, because companies have to consider a wide range of uncertainties concerned with the environment, society, and economics. This literature review shows that resilience is the prevailing way of thinking in the area of sustainability studies, and the main contribution of resilience to sustainability is how to deal with uncertainties. However, there seems to be a scarcity in the current literature on the conceptualization of resilience in the context of innovation. From the duality view, this paper proposes a new concept of innovation resilience based on two dimensions, stability and adaptability, which contribute to maintaining a high level of innovation efficiency, while at the same time adapting to change. The proposed innovation resilience concept attempts to provide an integration of divergent research streams—innovation management, organizational resilience, and sustainability management theory. We develop a conceptual framework that consists of a set of indicators involving the two dimensions by using multiple case studies, upon which future empirical studies can be based.

**Keywords:** uncertainty; resilience; sustainable innovation; innovation resilience

## 1. Introduction

Environmentalism is an evolving institution and is associated with three different conceptualizations—from the emergence of “sustainable development” in the 1980s, to “sustainability” in the 1990s, and more recently, an offshoot towards “resilience” [1]. Sustainability is often operationalized as the triple bottom line—using environmental, economic, and social indicators to measure performance [2]. Since the turn of the 21st century, these three categories of indicators have been perceived as inadequate for predicting and handling the risks and uncertainties needed to achieve sustainable goals [3]. The important contributions of resilience are its specific views on dealing with risks and uncertainties. Van der Vegt et al. (2015) suggest, in the editorial of *Academy of Management Journal*, that resilience is an effective and efficient management strategy focusing on the capabilities and capacities that create or retain resources to cope with and learn from uncertainties [4]. Through the cultivation of organization resilience, it may be possible to develop an innate ability to proactively adjust to environmental risks and uncertainties, and to seek opportunities from them.

Hence, in an uncertain and complex environment, sustainable innovation that aims at realizing sustainability through constantly meeting the environmental, economic, and social requirements needs to be supplemented with new methods for resilience management. Innovation is a highly risky process, and the innovative outcomes are uncertain [5–8]. These uncertainties include whether the technology will be feasible, whether the market will still exist, whether a different and successful business model

will emerge, whether the rules of the industry will be changed, and so on. A key innovative capability underpinning sustainable innovation is therefore the capacity to handle risks and uncertainties in order to prevent, endure, and recover from disruptions [1].

In most of the definitions found in the literature, resilience is identified as an inherent attribute of a system [9–11]. From this view, the capacity-based operationalization of organizational resilience is developed [12–14]. However, only sporadic research discusses organizational resilience and innovation management together [13,15–17]. For instance, Oeij et al. (2016, 2017) firstly propose and define “innovation resilience behavior” as a set of team competencies, which can make a team bounce back on the right track once they have chosen to take or are already taking an ineffective course (a mishap) with regard to its innovation goal [16,17]. Moreover, prior literature seldom discusses resilience in the context of innovation management at an organizational level. Therefore, there is a need for a further and holistic research summarizing the characteristics or attributes that a resilient organization presents in terms of its innovation strategy, process, routine, organizational culture, structure, and so on.

Accordingly, our aim in this paper is conceptualizing innovation resilience and proposing the key elements for building it. In other words, the research question in this study is what characteristics and capacities the organizations need in order to deal with the risks and uncertainties of innovation. To solve this, we extract the major elements of organizational resilience concerned with innovation in extant literature, and examine them through multiple case studies. The rest of the paper is structured as follows: the next section presents the literature review, followed by a description of the research design; based on the grounded theory method, the subsequent section illustrates the data analysis and results through coding; and finally, attention is drawn to the discussions and implications of innovation resilience, and conclusions and future research directions are presented.

## 2. Literature Review and Theoretical Foundations

### 2.1. The Concept of Resilience

The term “resilience” has evolved from the original ecological definition given by Holling (1973) as “a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables” [9]. This definition emphasizes persistence in the face of a disturbance. Afterwards, the publications of resilience are interdisciplinary from the natural science, such as ecology [18–20] and engineering management [21], to the social world, like economics [22], organizational management [23], strategic management [24], and supply chains [25], and multi-level from nation [26] and organization [23,24] to individual [27,28].

Social-ecological resilience is broader than its initial relatively narrow focus [9], which is the capacity of a system and its component parts not only to bounce back, but also to adapt and transform [20,29]. The two poles of resilience are stability and adaptability, and the trade-off between them is resilience [23]. A resilient system can be stable when a given shock is small, and can be adaptive in a time of greater shocks. The two poles are not opposite, but interdependent, and stability is an essential condition that provides foundations for constructing adaptability.

On an organization level, management literature has discussed resilience as an ability to survive in the turbulent business environment [30]. Environmental turbulence means technological change, demand uncertainty, and competitive shifts [31], as well as complex regulatory and legal factors [32]. Organizations have two important ways of responding to environmental turbulence, namely adaptive fit and robust transformation [12]. When environmental turbulence is more predictable, organizations emphasize an adaptive fit, otherwise, they focus on robust transformation. This attribute is reflected in the definition of Lengnick-Hall et al. (2011), “organizational resilience is the capacity to act robustly in the face of environmental turbulence and to adapt to the ongoing environmental changes” [33].

In the field of supply chain management, resilience is multidimensional and hierarchical, and also includes proactive and reactive aspects [34–36]. We have reviewed the current resilience research on

ecology, social-ecology, organization management, and supply chain management, and found that resilience consists in general two main integral parts: stability and adaptability.

## 2.2. Stability and Adaptability

Stability is an organization's ability to withstand stress and to thus avoid a loss of function in the face of environmental turbulence [37–39]. This term originates from engineering management references, and engineering resilience is defined as a system handling large stresses and returning to normal quickly after these stresses [21]. Resilient organizations are able to withstand, recover from, and still survive after disruptions. The characteristics of stability include a strong sense of purpose, core values and a genuine vision [12,33], practical habits and over-learned routines [21], forecasting capability, and behavioral preparedness [10]. Stability helps resilient organizations cope with disturbances through three steps, as follows: firstly, buffering impacts, which is reducing the organizational vulnerabilities to risk environments [40]; secondly, absorbing shocks, which is coping with the unexpected difficulties or complexities [12]; and thirdly, returning to a pre-shock situation, which is recovering from these situations [41].

Adaptability refers to the ability of an organization to adjust to environmental change, to take advantage of opportunities, and to create a fundamentally new system. This term is from the social-ecological definition of resilience, as “the capacity of complex systems to survive, adapt and grow in the face of turbulent change” [42]. Adaptability embraces learning, experimenting, adopting novel solutions, and developing generalized responses to foreseen or unforeseen events [20]. An adaptive system could create foresight and recognize, anticipate, and defend against adverse consequences before uncertainties occur [10]. Adaptability facilitates organizations to keep pace with environmental change and even create new opportunities [33,37,43]. Adaptability can be promoted by information and knowledge [14], enterprise integration and architecture [11], deep social capital [12,33], and mindfulness [44].

## 2.3. The Relationship between Stability and Adaptability

The mechanisms and activities that support stability and adaptability are generally seen as incompatible and are mutually exclusive. Most organizational theories scholars have maintained that stability and adaptability are paradoxical in the terms of resources, organizational structure, operational mechanisms, and cultures [45–48], and these two elements jointly contribute to organizational effectiveness and must be a trade-off [49,50]. In this view, Buliga et al. (2016) propose that stability and adaptability highlight the two poles of the resilience continuum, with some resilient organizations emphasizing stability, with others focusing on adaptability [51].

The duality view is that stability and adaptability are not separable and conflicting, but are interdependent [52]. Duality denotes the two-fold character of an object of study without separation [52,53], and it provides a common platform for addressing diverse issues such as stability and change [52], efficiency and flexibility [46,49,50], exploitation and exploration [45,54], and formalization and flexibilisation [55]. From the duality view [52,56], this paper proposes stability and adaptability as interdependent and mutually enabling, rather than separate and opposite. In order to survive and prosper, organizations must reconcile the paradoxical relationship of stability and adaptability [54,57,58].

Eisenhardt et al. contend that balancing stability and adaptability often occurs by unbalanced efforts that favor adaptability [46]. The mechanisms for unbalancing include heuristics-based strategic processes [59], modular business unit structures [60], and strategic alliance networks [61,62]. Heuristics are rules of thumb that provide efficient guidance for some actions, but, just as importantly, they also leave room for flexible adjustment in real time for other actions [59]. Modular business unit structures enable executives in multi-business organizations to adapt to changing markets by adding, removing, and recombining firm resources [60]. Strategic alliances with forward-thinking partners help organizations anticipate and adjust to change [62].

#### 2.4. Innovation and Organizational Resilience

A complex, turbulent, and uncertain business environment creates a need for resilience, which could be beneficial to organizational innovation. The case study of Richtnér and Södergren (2008) shows that resilience enabled by four pre-conditional resources, that is, structural, cognitive, relational, and emotional resources, which are particularly important in innovation projects [63]. Richtnér and Löfsten (2014) suggest that a resilient organization is also a creative organization, for organizational resilience is positively related to organizational creativity [64]. Akgün and Keskin (2014) empirically test the impact of organizational resilience on firm product innovativeness and performance, and find that resilience is positively related to firm product innovativeness [13].

Also, managing innovation could improve the organizational capacity for resilience. Resilience means a sustained superior performance, that is, resilient companies can always maintain a high performance and can self-renew over time through innovation. Reinmoeller and van Baardwijk (2005) indicate that the most resilient companies are those that continually orchestrate a dynamic balance of four innovation strategies, that is, knowledge management, exploration, cooperation, and entrepreneurship [15]. Business models are structural templates of how firms run and develop their business on holistic and system-levels, which include three main dimensions, namely, value creation, value proposition, and value capture. Business model innovation requires these three dimensions to be adjusted in order to adapt to the changing environment. Therefore, business model innovation can improve organizational long-term resilience [65]. Business model innovation signifies a pronounced readiness for adaptation, and can be viewed as being corresponding to the adaptability pole of the resilience continuum [51].

#### 2.5. Stability and Adaptability in Innovation Process

The literature of organization and management theory (OMT) provides a framework for analyzing innovation management at the level of the individual organization. Based on OMT, Phillips (2014) has identified three dimensions of organization as being of particular importance to innovation, namely: culture, leadership, and teams [66].

Organizational culture is important and needs to be considered when managing innovation. Culture shapes the attitudes and behaviors of individuals, and cultural norms define what is encouraged, discouraged, accepted, or rejected within an organization [67]. As culture influences employee behavior, it may lead employees to accept innovation as a fundamental value of the organization [66]. Creative culture is characterized by trust and openness, challenge and involvement, support and space for ideas, conflict and debate, and risk taking and freedom [68].

Innovation is often disruptive, risky, and costly, so support from leaders has a critical role in innovation. The upper echelons theory argues that the decisions and choices of leaders have a positive or negative influence on the performance of an organization. Leaders are important for the success of innovation, because of their central role in defining organizational processes, designing structures, shaping culture, and influencing employees' behavior [69]. Effective leadership in successful innovation includes the following traits: bright, alert, and intelligent; seeking responsibility and taking charge; skillful in their task domain; administratively and socially competent; energetic, active, and resilient; and good communicators [68].

Innovation is primarily about combining different perspectives for solving problems, and it can be achieved by teamwork. Therefore, team effectiveness is a critical determinant of innovative project success [70]. Cross-functional teams can bring more knowledge and information, and can increase the likelihood of building and improving upon the ideas of others. Then, innovation processes should become more effective and the outcomes of innovation could be improved. The key elements in effective high-performance team working include the following: clearly defined tasks and objectives, structured freedom, collaborative climate, and embracing uncertainties [14,26,71].

Stability involves standardization, modularization, institutionalization, and systematic planning, and focuses on the efficiency of innovation in a low-changing, predictable context. Adaptability is

targeted at flexibility in high-variation and unpredictable environments that require companies to conduct adaptable, innovative mechanisms, like exploration, experimentation, and improvisation. Stability-oriented and adaptability-oriented innovation activities are largely heterogeneous in aspects of the cultural atmosphere, leadership strategy, and team structure.

We connect stability and adaptability to the three dimensions of innovation (Table 1), and find that managing innovation must embrace the paradox of stability and adaptability. Innovation management needs a consistent, stable, and inherited culture in order to be stimulated efficiency. On the other hand, a creative atmosphere is required in order to encourage new ideas and innovative behavior. In an innovation process, top leaders should make strategies according to experience and should solidify rules, norms, standards, and routines, while simultaneously paying more attention to weak signals in environmental trends, establishing early warnings, making different experiments, and learning from failures. For the dimension of team structure, a stable organizational structure contributes to providing high-quality and low-cost products or services with economies of scale and scope, but inhibits creativities and resists change. A relatively more dynamic organization structure enables companies to respond quickly to environmental change by speeding up the information flow and sharing, facilitating intra-organization collaboration, and making fast and accurate decisions.

**Table 1.** Criteria for understanding stability and adaptability in innovation processes.

Dimension	Stability	Adaptability
Culture	A consistent, stable, and inherited culture. Outperforming repeated work with scrupulousness.	A creative atmosphere. Encouraging new ideas and innovative behavior.
Leadership	Systematic strategy plan. Path-dependence and rule-following.	Dynamic and flexible strategy. Allowance of various trajectories in parallel and a high tolerance of uncertainty.
Team	A stable organizational structure. Standardization, routines, and institutionalization.	An organic organizational structure. Authorization, openness, and improvisation.

## 2.6. The Concept of Innovation Resilience

Based on the discussions above on resilience and its links with innovation, we have found that there is only limited attention to the elements of resilience in the innovation management area. Alblas and Jayaram (2015) define design resilience as the ability to cope with uncertainty through alternating the design by using either active or passive design flexibilities, which are restricted within the fuzzy front end of innovation [72]. We follow their definition of design resilience, and the view innovation resilience as the capability to cope with the uncertainties associated with innovation. The literature review in the second chapter shows that stability and adaptability are integral parts of resilience, which provide implications for constructing and measuring resilience from the two primary dimensions. From the duality view [46,52,53,56], stability and adaptability are interdependent and enable each other, and a resilient organization has the two capacities simultaneously. Therefore, we developed the definition of innovation resilience as follows: innovation resilience is the capability of an organization to cope with the uncertainties associated with its innovative activities through effectively integrating stability and adaptability.

## 3. Research Design

### 3.1. Research Method

According to Yin (2003) [73], a case study is suitable for either “how” or “why” research questions [66]. As this study is exploratory with the question “how can organizations build resilience to deal with uncertainties in their innovation management process”, the multiple case study method is



used in this paper. The multiple-case research design follows a replication logic integrating the data from different individual companies, which are treated as independent experiments and are separately studied. The information from each enterprise has been collated in order to explore the common components of innovation resilience, which can effectively reduce the bias caused by the researchers' subjectivity, and can improve the theoretical saturation and reliability.

### 3.2. Case Selections

In order to construct an integrative conceptual framework of innovation resilience and provide useful suggestions for an effective response to the uncertainties concerned with innovation, the selected case companies must be representative and strongly competitive in their industry, have excellent innovative capabilities to survive and prosper for more than twenty years, and be involved in perfectly competitive (rather monopolistic) industries. According to the above criteria, four Chinese companies have been selected for our study, namely: Haier, Huawei, Tencent, and Neusoft. Furthermore, the reasons we selected these four companies lie in that through the replication of the case studies conducted for individual, representative companies from different industries, we can explore, using more reliable evidence, the common characteristics of these companies that are capable of innovation resilience, and can therefore provide general research findings. Table 2 outlines the key information of the four selected cases, including the turbulences or challenges related to their business activities and the resilient responses they have made. Next, we will describe the individual cases in detail.

**Table 2.** Description of cases.

Company	Huawei	Haier	Tencent	Neusoft
Year established	1987	1984	1998	1991
Main business	Information and communication technology solutions, products, and services	Household appliance manufacturing	Social and communication, online games, digital content, advertising, and payment-related services	Information technology (IT) solutions and services provider
Environmental turbulence	Competition from excellent global companies and uncertainty in the development of information and communications technology	Decreasing demand as a result of a slowdown in macro-economic growth, intensifying industry competition	The advent of the mobile Internet era that migrates social communication from personal computers (PC) to mobile terminals	Varied and changing customer requirements from the different industries served
Resilient response	Continuously improving our operating performance and investing heavily in research into technology and business models	Networking strategy: a platform oriented to incubator makers in the whole society and achieving a win-win and the added value of interested parties	Establishing internal entrepreneurial, disruptive, and innovative activities to proactively build a social network platform	Creating a bottom-layer platform that caters to enterprise-wide application development and deployment

**Haier:** As a response to the decreasing demand and intensifying competition in the household appliance industry, Haier turned its organizational structure into a platform that incubates entrepreneurs across society. By the end of 2013, the Haier Group proposed a disruptive strategy, namely “enterprise as a platform, employees as entrepreneurs, and users as distinctive individuals”. Taking users as the center, the sequential mode of research and development (R&D), manufacturing, and sales was changed into a parallel one, where all of the parties served the users. The staff were changed from employees into innovators, from passive performers to active entrepreneurs, in response to the customers' individual needs. The establishment of micro-enterprises with independent operating rights attracted social resources to directly match the needs of the users.

By breaking the hierarchical and institutional structure, Haier built a functional platform integrating common functions, such as financing, legal affairs, production, logistics, and customer

service, which therefore reduces the production costs and realizes the economies of scale and scope through sharing basic modules. It turns differentiated business units into independent operating entities with a high degree of autonomy, in order to capture the changes of customer demand immediately and improve the enterprise's innovative ability. The core was to build a platform between the first-class resources and users to realize fast allocation, releasing the same and cross boundary values of the network, agilely capturing the opportunities brought by the market changes, and quickly providing customers with satisfactory products or services.

**Tencent:** With the advent of the mobile Internet era, Internet giants needed to migrate from personal computers (PC) to mobile terminals, which was quite a great challenge. At that time, Tencent's QQ (PC-based social and communication software) was very popular and influential, but in the face of the disruptive technology of the mobile internet terminal and market changes, Tencent's executives came up with a consensus that internal disruption was better than competitors' disruption. Specifically, Tencent's approach was to establish small project teams based on the internal entrepreneurial mindset, and to innovate similar start-up companies, staying away from the influence of the big enterprise culture. Finally, it released WeChat (a mobile text and voice messaging communication service) in 2011, which has now become a social network platform with extensive advantages and market share.

Zhang Xiaolong, recalling the entire R&D process, said that at the beginning, they had a dozen people in a small team in operation, rather than a large team in operation. Many jobs no longer relied on a large organization, but on several capable small teams. Zhang also said that "in the WeChat team, we try to divide into small teams, so the efficiency is higher". In the development process, the R&D team of WeChat often came up with erratic ideas, even something radical, but their practices were not obstructed. In addition, in order to increase the competitive pressure, Tencent had three teams developing similar products at the same time, and finally WeChat stood out.

**Huawei:** After their initial success in the countryside market, the founder of Huawei, Ren Zhengfei, emphasized the dominated position of stability and introduced formalized management system with the help of foreign consulting companies, so as to match with its rivals from developed countries. Since 1998, Huawei invited IBM and other world-renowned consultants to launch standardized and advanced technologies and processes, such as integrated product development, integrated supply chain, and customer relationship management, which resulted in greatly improved controllability and efficiency. Then, Huawei established a unified management platform and process system that supported its arrival as one of the world's top electronic information equipment suppliers.

Moreover, a number of process control points were set up at that time so as to manage their operational risks. However, an internal bureaucracy and dogmatism emerged along with the rapid expansion. Decision-makers began to stay away from the business line and the front-line staff spent a lot of time in frequent contact with them. Thus, many opportunities were missed. In order to keep keenly identifying the development of the industry, Huawei set up a special self-critical mechanism—the Red and Blue Army. The Red Army acts on behalf of Huawei's current strategic model, while the Blue Army represents the competitors' or innovative strategic model. For the Blue Army, their main task is to sing a different tune, to put forward all possible problems, and to even give a warning. Through the confrontative system, the board of directors receives a series of effective recommendations to ensure that Huawei's innovation is on a correct path.

**Neusoft:** Founded at Northeastern University in 1991, Neusoft is a global provider of information technology (IT) solutions and services, and is the first listed company in the China software industry. In 2016, Neusoft was named one of the "Global Software Top 100 Companies", ranked by the PwC consulting company, and it was the only Chinese company on the list. Neusoft provides IT solutions for various industries such as telecom, energy, manufacturing, healthcare, education, transportation, and so on. During the process of providing solutions to customers in different industries, Neusoft found that there was a lot of repetitive work and the software development was inefficient. It was urgent for Neusoft to accumulate common components and reusable technologies in industry solutions, which would be abstracted and encapsulated for reuse.

In this context, the middleware product, Unified Enterprise Application Practices (UniEAP), was developed, which includes two categories of components, general technical ones and customized ones. The former can be applied to various industry solutions, and the development efficiency is improved. The latter is suitable for the specific business settings, and the diversified user demands can be satisfied. If the industry solution is referred to a building, UniEAP is compared to its foundation and framework. The design and development team could skip the basic work, and concentrate on developing additional modules according to the industry-specific features. The components reuse and the assembly assists in knowledge sharing and transferring, so Neusoft achieves the balance of efficiency and flexibility in software development, and has a leading market share.

### 3.3. Data Collection

We collected the relevant information from a variety of sources, including first-hand and second-hand information. The variety of evidence forms a confident triangle and ensures constructing validity, because different sources of evidence have multiple proofs of the same phenomenon [73]. The first-hand information is mainly from semi-structured interviews with management officers. The sources of second-hand information include the following: (1) the corporate website; (2) papers related to the case study companies published in peer-reviewed academic journals; (3) the public business surveys, such as the investigation of sustained innovation of Chinese listed companies; (4) and the annual reports.

Specifically during the interview, we combined the theoretical background of organizational resilience and OMT to propose 16 semi-structured research questions, which are classified by stability and adaptability, in the protocol for each interview (see Table 3), which provide a basic idea for the following case studies so as to ensure that the analysis does not deviate from our aims and objectives. If some important materials that are not included in the research questions above emerge in the specific case analysis process, we retained them and made a supplementary construction. For each company, we conducted more than three in-depth interviews with the top management team, and we further completed the research questions with detailed information from involved first-line managers and other employees. In total, we conducted 52 interviews (17 interviews with top managers) that consumed 6215 min.

**Table 3.** Semi-structured questions in the interview protocol.

Aspects	Research Question
Stability	1. Does the organization has a clear rules and regulations for innovation?
	2. Do the innovation process have a corresponding support platform?
	3. Does the organization have supervision for innovation?
	4. What is core technological capability of the organization?
	5. Does the organization have a clear strategy and direction for innovation?
	6. Does the organization have a shared vision for innovation?
Adaptability	7. Are talents for innovation are diversified?
	8. Are there integrated diversified resources in the process of innovation?
	9. Is open innovation adopted?
	10. Whether the organization attaches importance to a win-win situation with its stakeholders?
	11. How sensitive is the organization to markets?
	12. Is innovation customer-oriented?
	13. Is the organizational structure flexible?
	14. Are there innovative teams in the organization?
	15. How does the organization authorize innovative teams?
	16. Are employees active and creative in the innovation process?

## 4. Data Analysis and Results

The grounded theory method that has been widely used in qualitative research, and was conducted for coding the data in our case studies. The data analysis involved the following basic steps. The first step was open coding, using each of the case-study organizations that were individually



analyzed. The interviews and other sources of information were conceptualized line by line. The second step was the selective coding. The results of each company were coded to look for the common characteristics and capabilities dealing with the uncertainties across the case studies. The concepts yielded in this step were the tentative third-level indicators. Then, the theoretical codes integrated as organizational resilience and innovation management theory, and the indicators were clustered into six categories in line with the dimensions identified in the literature reviews. Finally, 17 innovation resilience indicators were generated, and were confirmed with evidence provided in the literature of the organizational resilience and innovation management of the cases studied (see Table 4). Next, we individually demonstrated these indicators.

#### 4.1. Stability and Culture

**A strong core identity and unified commitment.** A strong core identity refers to the shared understanding and identification of the core values and vision of an organization among its organizational members, which contributes to individual members' productive degree of commitment and self-sacrifice in order to reach the organization's goals. As for innovation, a prevailing language (i.e., words, images, and stories) enables an organization to achieve a consensus on the organizational innovation goals among its members and to motivate its members' accountability and passion for accomplishing these goals. In Haier, for example, innovation is imprinted as the "Haier Doctrine", and its meaning is constructing the mechanism and platform for cultivating first class talent to continuously create value for customers, thus forming the win-win culture of the individual-goal combination. Furthermore, the value propositions related to innovation in other companies studied include Huawei's building "a better connected world" through continuously creating value for their customers and society with innovative information pipes; Tencent's "integrity + proactive + collaboration + innovation", which takes users' needs as the first priority in order to enhance the quality of life through reliable, creative, enjoyable, and convenient Internet services; and Neusoft's "simplicity + accountability + collaboration + respect + integrity", which aims at becoming a globally leading IT company through continuous organizational and process optimization, and a commitment to strategic alliances and open innovation.

**Employee well-being.** Here, employee well-being refers to the employees' responsibility and accountability, sense of ownership, attractive incentives, and career development [74], along with the psychological safety conducive to taking interpersonal risks of being seen as ignorant or incompetent by asking questions, speaking the truth, seeking information, and experimenting [75]. It provides a respectful, trusted, and cooperative working environment for employees to fulfill their personal ambitions and social needs aligned with organizational goals, as well as a sense of responsibility and importance to the organization that is beneficial for dealing with challenges and uncertainties. Generally, higher salary remuneration and benefits than the average of industry and satisfactory career development paths can largely increase employee happiness. Take Neusoft for example, it believes that a respectful, open, and fair work environment is fundamental for staff development and organizational innovation, and therefore actively provides employees with a safe, clean, comfortable, and free work environment, along with compensation and benefits suited to the local consumption level. In order to actualize the synchronous progress of the staff and the company, Neusoft helps employees to promote their personal abilities and professional competitiveness. Haier also highly values their employees' creativity, and its mission is to let every employee have the chance to become a CEO. As Huawei has often said in recruitment, "We are not hiring staff, but partners". With this in mind, Haier made its organization open, stimulated the creativity of innovative workers, gave individuals the right to operate business independently, and advocated for employees to conduct self-management.

**Table 4.** The indicators from multiple case studies as well as the supporting literature.

Factors of Innovation Resilience	Descriptions from Literature References	Representative Actions from Cases Studied
<i>Dimension: Stability and Culture</i>		
Core identity and commitment	The core value related to organizational innovation, which is often manifested by a prevailing language, enables an organization to achieve consensus on organizational innovation goals among its members and motivates its members' accountability and passion for accomplishing the goals [12,33,37,76,77].	<p>Haier: The "Haier Doctrine" is innovation, and its meaning is constructing the mechanism and platform for cultivating first class talents to continuously create value for their customers, thus forming the win-win culture of an individual-goal combination.</p> <p>Huawei: Huawei is committed to building "a better connected world" through providing future-oriented, innovative information pipes and continuously creating value for their customers and society.</p> <p>Tencent: Tencent's core value is "integrity + proactive + collaboration + innovation", as well as being the most respected Internet enterprise, taking users' needs as the first priority in order to enhance their quality of life through reliable, creative, enjoyable, and convenient Internet services.</p> <p>Neusoft: Neusoft's value is "simplicity + accountability + collaboration + respect + integrity" and to become a globally leading IT company through continuous organizational and process optimization, and a commitment to strategic alliances and open innovation.</p>
Employee well-being	Employee well-being, including employee responsibility and accountability, psychological safety, attractive incentives, and opportunities for career development, provides a respectful, trusted, and cooperative working environment that inspires employees' dedication to organizational innovations and long-term development [74,75,78,79].	<p>Haier: The win-win mode of individual-goal combination provides the resources and mechanisms guaranteed for each employee to carry the two spirits of entrepreneurship and innovation, and allows each employee to actively and independently create innovations and new customer values in order to realize achievement.</p> <p>Huawei: Huawei provides a global development platform that gives employees the opportunity to shoulder greater responsibilities to and accelerate their careers, as well as contribution-based performance assessments and promotions that inspire the dedication of its employees.</p> <p>Tencent: Tencent invests in its employees as its management philosophy and sets a clear pathway for talent development, providing employees with trust, respect, attractive incentives, and opportunities for professional and personal growth.</p> <p>Neusoft: Neusoft respects employees' personalities, provides high compensation and benefits, and helps employees to promote their personal abilities and professional competitiveness through a systematic talent training program.</p>

Table 4. Cont.

Factors of Innovation Resilience	Descriptions from Literature References	Representative Actions from Cases Studied
<i>Dimension: Stability and Leadership</i>		
Long-range innovation strategy	Leaders need to champion an informed strategy for organizational innovation, set a long-range course of action and implementation, and promote cross-functional collaboration and critical resource exchange [14,24,26,74,80,81].	Haier: In the Internet age, Haier aims at building a platform that incubates entrepreneurs for co-creation, as well as becoming a networked enterprise that can connect to a myriad of resources and facilitate the interaction of user values. Neusoft: The excellent center facilitates the sharing and reuse of common methods and the transfer of specialized resources and technologies, thus promoting the exploration of new ways to overcome key technical problems.
Core technological capability	Core competencies that bring competitive technologies and resources can reduce innovation uncertainties [12,13,33,74].	Huawei: Huawei's innovation takes the pipeline of data transmission as its main battlefield, as its employees could not blindly innovate, and went beyond its strategic objectives and opportunities. Neusoft: Neusoft's outperformance is closely related to its clear positioning in solutions and software services rather than as an IT product provider, which has gradually guided its comprehensive solution framework and business ecosystem.
<i>Dimension: Stability and Team</i>		
Formal mechanism and platform	The formal mechanism and platform supporting innovation is helpful to reduce the entire product development cycle and to increase the efficiency and effectivity of innovation [82–84].	Haier: The win–win model of the individual-goal combination makes employees the leaders in independent innovation. Huawei: Integrated product development (IPD) was introduced by Huawei in order to improve their research and development (R&D) efficiency, and therefore contributing to responding agilely to customers' needs.
Clear rules and regulations	A series of clear rules and regulations is conducive to achieving desirable innovative outcomes [66,85,86].	Huawei: The basic law provides a comprehensive specification covering the operation, marketing, R&D, production, structure, human resources development, finance control, and so on. Haier: The early rules and regulations that have been established specifically constrain the staff's daily behaviors, which means that employees take small mistakes seriously, figure out the real reasons behind the problem, and search for solutions to in order improve their performance.

Table 4. Cont.

Factors of Innovation Resilience	Descriptions from Literature References	Representative Actions from Cases Studied
Supervision and monitoring	Supervision and monitoring systems are necessary for improving the progress of innovation [87–89].	Huawei: Authorized employees are under supervision as they needed to report the progress and problems of work regularly. Haier: Haier’s micro-enterprises are divided into different types based on their performance evaluation, and are accordingly supported with improved measures.
Effective communication	Creating effective communication pathways and breaking down a silo mentality is essential in order to integrate independent units in an organization [4,14,33,80,90,91].	Neusoft: The solid practice of open and collaborative innovation in Neusoft is backed by established, clear communication channels; coordination mechanisms; and evaluation principles that help shape an environment that emphasizes knowledge sharing and transferring.
<i>Dimension: Adaptability and Culture</i>		
Supportive and innovative culture	A soft environment that encourages new ideas and supports the experimentation of new ways of working is essential for employees’ creativity and innovation [80,92–94].	Haier: Haier established a “closed-loop network of nodes” characterized as equality and decentralization to maximize entrepreneurs’ creativity. Huawei: The incentive mechanism made employees face market directly and always feel the need for innovation to keep growth under competition. Neusoft: Entrepreneurs are encouraged by employee stock ownership and other reward schemes and are supported by the integrated resource platform.
Risk-taking culture for innovation	Moderate tolerance of failure, uncertainty, and ambiguity is necessary for companies to undertake initiatives to adapt to the changes in complex and uncertain environments [71,95].	Huawei: Huawei has developed a special mechanism, the Red and Blue Army, in order for the organization to develop strategic decision-making criticism to establish progressive and robust strategic planning processes.
Employee’s self-directed learning	A learning culture is essential for staff development and organizational innovation, as it facilitates the automatic capture of new knowledge, active creativity, and learning from failures [74,96].	Huawei: Huawei University, established in 2005, formed a systematic personnel training management program that supports its strategy implementation, business development, and human capital appreciation. Neusoft: Neusoft clearly defines a skill development map and helps employees to enhance their practical ability through project training, tutor training, self-learning, and e-learning platform.

Table 4. Cont.

Factors of Innovation Resilience	Descriptions from Literature References	Representative Actions from Cases Studied
<i>Dimension: Adaptability and Leadership</i>		
Leader mindfulness	Sensing weak signals of environmental changes is critical for the subsequent effective response and continuous progress [13,14,24,44,90,95].	Haier: Zhang Ruimin, the founder of Haier, advocated for mindfulness across the company in order to find improved and different solutions. Huawei: Ren Zhengfei, the founder of Huawei, frequently mentioned that “Huawei’s winter was coming” to promote the recognition of the inevitable fall of their current success.
Concentric diversification	Concentric diversification based on a core technological capability contributes to buffering environmental shocks and promoting internal innovation through the diverse knowledge accumulation [15,24,71,74,95,97].	Haier: Since established in 1984, Haier’s business lines have extended from refrigerator and white goods (washing machines, freezers, air conditioning, etc.) to black appliances (color TV, audio, game consoles, etc.). Neusoft: Neusoft put forward the “beyond technology” strategy in 2005 and gradually began a diversified strategic development, entering the fields of health management services, energy vehicles, auxiliary driving, and other areas.
<i>Dimension: Adaptability and Team</i>		
Diversified talents	Employees with diversities, in terms of education level, profession, work experience, and gender, contribute to providing various innovative solutions [95,98].	Haier: Haier established a talent ecosystem that allowed online staff to use its platform for new ventures, without labor contracts with Haier. Huawei: Huawei invited talent in a wide range of areas in order to facilitate different thinking and to inspire creativity and innovation. Neusoft: Neusoft attracts non-IT staff to join the company so as to provide improved IT solutions and services for customers from different industries.
Flexible organizational structure	Flexible structures encourage employees to experiment, improvise, and self-organize with new information, thus coping with environmental changes in a quick way [11,95,98].	Haier: Haier has established a structure consisting of a large number of small and independent autonomous front-ends (micro-enterprise) that are supported and coordinated by a common resource platform. Huawei: Huawei provides project-based teams with adequate authorization and access to company-wide resources.

Table 4. Cont.

Factors of Innovation Resilience	Descriptions from Literature References	Representative Actions from Cases Studied
Flexible authorization mechanism	Empowered employees are able to explore all of their capabilities and entrepreneurial spirit in order to innovate with new insights and information [4,13,26,33,77].	<p>Huawei: Huawei has created the iron triangle structure composed of customer managers, solutions experts, and delivery experts working on innovative projects.</p> <p>Tencent: Tencent established internal small project teams that stayed away from the influence of the big enterprise culture.</p> <p>Neusoft: Neusoft provides adequate authorization for departments to carry out innovative projects with their own budget and strategy.</p>
Open innovation and cooperation	Widely building cooperative relationships with other players contribute to acquiring critical resources, enhancing competitiveness, and shortening the product development [14,26,71,74,95].	<p>Haier: Haier has developed the online Haier Open Partnership Ecosystem (HOPE) so as to promote the sharing of knowledge and resources with global partners as well as excellent, creative solutions.</p> <p>Huawei: Huawei has established joint laboratories with competitors and has borrowed mature technologies from other companies.</p> <p>Neusoft: Neusoft constantly searches for advanced technology and novel business models through alliance and cooperation, and actively participates in the global division of labor.</p>



#### 4.2. Stability and Leadership

**Long range innovation strategy supported by leadership.** Leaders should identify and analyze environmental trends from a long-term lens, determine a course of action in light of the analysis, and carry out the decided course of action. Besides, as effective innovation is mainly achieved by wide internal knowledge sharing and dissemination, leaders should be dedicated to encouraging employees to report critical information timeously and promote cross-functional collaboration. Under Haier's new networking strategy, in line with the Internet age, the relationship between its micro-enterprises and platforms is no longer the traditional "upper and lower". Instead, a contractual relationship is established to facilitate the exchange of resources among the micro-enterprises, as well as between the micro-enterprises and platforms. The core principle of such a relationship is the marketization of value, that is, an individual-goal account (including asset, expense, and remuneration) is created for each employee to be clear of the value he or she creates for users. Similarly, the excellent center at company-level established in Neusoft helps effectively manage and transfer specialized resources, thus realizing the sharing and reuse of common methods and technologies, as well as the exploration of new ways to overcome key technical problems. The individual business units have easy access to the company-wide resources through the center so as to promote the development of their own business, and to then maximize the company's overall technical capacity.

**Core technological capability built by leadership.** Leaders build core competencies to capture sustainable competitive advantages, which include employee knowledge and skills, technical systems, managerial systems, values, and norms. Many companies invest a lot of time and money in innovation, but the result is often frustrating because of the lack of core capabilities, which brings competitive technologies and resources, and can reduce innovation uncertainties. Neusoft's outperformance is closely related to its clear positioning, that "Neusoft is a company that providing solutions and software services, not software products". With the strategic objectives early identified, Neusoft gradually constructed a comprehensive solution framework, made a large number of components and products, provided a business system for partners, and formed a solid customer base. Similarly, Huawei's innovation is focused on the pipeline of data transmission, as the founder, Ren Zhengfei said, "Everything in the world follows a normal distribution, and we only do the things in the central of the normal distribution curve, abandoning the others". Revolving around this main battlefield, employees cannot blindly innovate and are required to be initiative and creative for specific strategic objectives and opportunities.

#### 4.3. Stability and Team

**The formal mechanism and platform supporting innovation.** Organizations should structure ways for effectively managing innovation process from creative idea generation to successful implementation; in short, platforms supporting new product development. We found that each case company has a relatively formal innovation system and processes, to ensure that their goal of innovation can be achieved. For example, Haier is now operating the win-win model of individual-goal combination, that is, employees have the autonomy to make decision in response to changes in the market, and the right to determine their income in line with the value they create for users. This new pattern of relationship between the enterprise and employees makes employees become the leaders in independent innovation. Early in 1988, IBM's integrated product development (IPD), a complete set of standardized process systems for product lifecycle management regarding product requirements analysis, planning, development, and launch, was introduced by Huawei. It contributed largely to minimizing the entire product development cycle, reducing costs through platform and modularity, and efficiency improving the R&D and product quality, which allowed Huawei to respond agilely to customers' need.

**A series of clear rules and regulations.** Organizations that have a series of clear rules and regulations can largely improve their innovative outcomes. Institutions and innovations are sometimes thought to be contradictory, for innovation cannot always strictly adhere to the existing rules. Evidence

from our cases shows that management institutions are both necessary and beneficial for innovation process, by means of controlling the behaviors of employees and ensuring that all people can do the right things and do things right. In Haier, the early rules and regulations established by the chairman, Zhang Ruimin, specifically constrained the staff's daily behaviors, and employees who violated them were punished or even directly dismissed. Consequently, employees no longer thought that small mistakes were tolerable, as they mattered to the "rice bowls". Take the overall every control and clear (OEC) management system as an example. It requires everyone to clean up the real reasons behind the problem every day, and to find a solution to improve the performance of the problem, and has now been internalized as each employee's conscious behavior.

**Supervision and monitoring system for innovation.** Organizations need to establish suitable reward and recognition systems to support and supervise innovation. Huawei did a good job in this regard, as its formulation of the basic law provided a comprehensive specification covering its operation, marketing, R&D, production, structure, human resources development, finance control, and so on. The authorization process, for instance, was in compliance with the certain principles involving the appropriation, controllability, responsibility, and dynamic evaluations, which guarantee that the authorization works effectively. In addition, the authorized people are under supervision, that is, they are asked to report the progress and problems of work regularly. Similarly, Haier's micro-enterprises are divided into different types based on their performance evaluations, which are marked as different colors (green, blue, yellow, and red) in the information system. The green micro-enterprises achieve their goals, but the red ones would be bankrupt because of a bad performance. Haier's platform helps the red and yellow micro-enterprises improve their performance and enter the blue and green areas as soon as possible.

**Creating effective communication pathways and breaking down silo mentality.** Effective communication pathways include informal and personal ways, such as casual conversation, phone calls, and meetings, and formal knowledge exchange, such as information technology systems. For instance, the solid practice of open and collaborative innovation in Neusoft is backed by established organizational structures, clear communication channels, operation models, and differentiated evaluation mechanisms that help shape an environment emphasizing systematic reuse, knowledge sharing, and competency development, as well as by the organizational technology capability model that helps to assess the strategy execution periodically and to identify weaknesses for sustainable improvement.

#### *4.4. Adaptability and Culture*

**A supportive and innovative culture.** Resilient organizations have an environment that encourages new ideas and allows for the development of new ways of working. A culture that supports innovation is characterized by trust and respect, which provides a soft environment that promotes creative ideas, tolerates conflicts and errors, and encourages employees to think imaginatively. Haier established a "closed-loop network of nodes", with the characteristics of equality and decentralization, so as to provide entrepreneurs with a creative atmosphere. Equality eliminated the job level, as the nodes replaced the hierarchical departments. Each node had a high degree of decision-making power beyond the constraints of vertical boundaries, maximizing their creativity. In line with the principles and business philosophy of the entrepreneurial leadership, and business sustainable development through information technology, Neusoft also makes efforts to create a more creative organization. Young entrepreneurs are encouraged by the employee stock ownership and reward scheme. Also, the integrated resource platform provides services and an ecological society with low risks for entrepreneurs. In Huawei, internal products are provided freely for entrepreneurs, and the entrepreneurs who fail can go back within six months. This incentive mechanism makes employees face the market directly and they always feel the cruelty of society and competition, stimulating them to keep growing.

**Risk-taking culture for innovation.** In order to survive and grow, enterprises must uphold the ability of self-reflection and self-criticism, which enables them to find their shortcomings and undertake initiatives so as to adapt to the changes in complex environments. A risk-taking culture means a high tolerance of failure, uncertainty and ambiguity, while the risk to be taken also needs to be managed with limited commitment. In this regard, Huawei developed a special mechanism, Red and Blue Armies, in order for the organization to develop strategic decision-making criticisms. The Red Army was on behalf of Huawei's existing strategic development, and the Blue Army was on behalf of one of the competitors. The Blue Army, acting as the anti-tune, criticized the strategies of the Red Army through reverse thinking, and pointed out the new development model. In 2008, Huawei planned to sell its mobile phones business, and the Blue Army found the important value of the terminal, and arranged for Huawei to carry out this business. Today, according to the data of the market research firm, Strategy Analytics, Huawei has become the world's third largest mobile phone manufacturers, second only to Apple and Samsung.

**Self-directed learning and staff development.** Innovation requires employees to actively create rather than passively work, continue to learn in order to overcome difficulties, and therefore achieve self-growth. Self-directed learning refers to the automatic capture and sharing of new knowledge and self-learning in the innovation process. Huawei is committed to building a learning organization. Huawei University was formally registered in 2005, for talent training and cadre selection. According to their strategy and human resources development, Huawei University has established a personnel training management system. The strategy implementation, business development, and human capital appreciation are achieved through the training of staff and management personnel. Based on its core vision and culture, the capability development model for individual was constructed in Neusoft, which makes employees gradually responsible for projects, architectures, solutions, industrial consultation, and business innovation. The business unit defined the skills map and then established the training system and the courseware according to its own business characteristic, and regularly evaluates the gap between the staffs' existing ability and the target ability. The employees are guided to develop the practical ability through the project training, tutor training, self-learning, and e-learning platform.

#### *4.5. Adaptability and Leadership*

**Leader mindfulness.** Crisis awareness or a sense of weak environmental changes is critical for proactive, continuous adjustment and adaptation that makes companies survive in this uncertain business society. In this regard, leaders should frequently create a forward-looking discussion between the internal and external constituents of the organization that facilitates the anticipation of what is going to come and the energizes the organization that to respond to the change. Zhang Ruimin, the founder of Haier, frequently advocates for mindfulness across the company by stating that that "there is no successful business, only the era of business", "success is the mother of failure", and "the peak of the glory is the beginning of the decline". Consequently, the people in Haier always maintain a strong sense of crisis and change awareness, and explore the new paths of organizational development. Facing changes in the environment, Haier could quickly return to "zero" and start again. Similarly, Huawei's sense of crisis originated from its high-level leadership and then penetrated the entire company. In 2001, Huawei's profits accounted for the first in top 100 electronic companies in China. At that time, Ren Zhengfei, the founder of Huawei, pointed that "Huawei's winter was coming". He said, "have all employees considered how we do, if one day the sales decline, the profits decline and even the company bankrupts?". Subsequently, Ren issued several crisis statements, including "the pay of everyone must be cut", "the best time of Huawei has passed", "it is essential that high-level has a sense of mission, the middle has a sense of crisis, and grass-roots are hungry". These crisis statements encouraged Huawei to climb to one after another high points, and to sustain a superior performance.

**Concentric diversification based on core technological capability.** Strategic heterogeneity is a key source of adaptability when an organization experiences an environmental shock, such as

discontinuous technological changes. Concentric diversification means building diversification strategies around core competence, which provides an open space for innovation and development through effectively reusing established, valuable resources and capabilities. Information technology is the core capability of Neusoft. Since 2005, Neusoft has put forward the “beyond technology” strategy, and has gradually started diversified strategic development. In 2009, Neusoft launched the healthcare management center, “Xi Kang”, and it formally entered the field of health management services. In July 2015, Neusoft and Alpine co-invested in the establishment of Neusoft Ruichi, which is committed to the innovation of new energy vehicles, auxiliary driving, and car networking, as well as other areas. From 1984 to 1991, Haier only made one type product, the refrigerator. By 1991, Haier’s refrigerator production exceeded three hundred thousand units, doing the best in China. On this basis, the company extended its product line to other white goods (washing machines, freezers, air conditioning, etc.). When its white goods market share was the biggest in China, Haier began to enter the field of black appliances (color TV, audio, game consoles, etc.).

#### 4.6. Adaptability and Team

**Diversified employees.** Organizations hiring talents with varied genders, personalities, educational backgrounds, professional experience, and working styles can provide a wide variety of specialized, high-quality skills and expertise to act. Due to such diversity, employees in an organization are active in challenging the dominant business logic that is proven to be successful. Innovative solutions to solve problems always need to integrate different views, and a diversified set of talents, therefore, is key to the success of innovation in the changing business environment. Since the beyond technology strategy (i.e., providing IT solutions and services rather IT itself) was implemented in 2005, the human resource in Neusoft has become open and the professional employees are more diversified than before, as more non-IT staff have joined the company. Neusoft’s healthcare management center, for example, has more than 1000 employees, and half of them are doctors or nurses. Software engineers and medical workers are fully integrated, and this is caused by the transition from IT to Internet people (IP). Consistent with its Internet thinking business strategy, Haier has established a talent ecosystem that introduces a new concept of talent, online staff, who use the Haier platform to start new business without labor contracts with Haier. With this effort, more diversified talents with entrepreneurship and creativity have joined Haier to use its platform for new ventures. Similarly, Huawei’s attitude to talent is open and inclusive, and scientists who have ideas in related fields are invited to join. As Ren Zhengfei, the founder of Huawei, said, “we are not narrowly looking for what kind of talent, but attract talents in a wide range of areas, so that different areas of thinking bring collision and inspiration for innovation”.

**Flexible organizational structure.** It relies on independent, autonomous teams; employee participation in decision-making; and flattened hierarchies that enable employees’ innovative behavior or improvisations so as to quickly cope with environmental changes and uncertainties. In order to stimulate the entrepreneurial spirit of innovation, Haier established a large number of small and independent autonomous front-ends consisting of the staff from cross-functional departments, which are given autonomy, and at the same time bear all or part of the profit and loss. As a result, nearly 4000 micro-enterprises form a huge radar network of firmly connected users, so that they can spontaneously capture the needs of the users and conduct new product development to precisely meet the user’s needs. Similarly, Huawei provides adequate authorization to the project managers, who have great power over the project budget as well as access to the resources required in order to perform the specific tasks for the customers’ demand. This user-oriented organizational structure breaks the bureaucratic layers and departmental silos, and transfers the original functional departments (such as finance, legal, production, logistics, customer service, etc.) into a platform that provides the services and resources needed to support individual projects, including demand crowdsourcing services, creative idea transformations, the latest technical information, and consulting and training.

**A flexible authorization mechanism.** In order to effectively manage innovation uncertainties, organizations need to adopt high-level teamwork based on the authorization of leaders, for empowered

employees who are able to explore all of their capabilities and their entrepreneurial spirit, aligned with the organization's objectives. Neusoft provides adequate support and authorization for innovative projects and holds an annual project reply, where different departments propose new projects for a unified audit. Once these projects are passed, the corresponding department decides the budget and strategy by itself. In other words, the department has enough power and resources to carry out its innovative project, and is also responsible for the results of the project. In 2009, Huawei reformed its organizational structure and human resource management to the iron triangle structure, composed of customer managers, solutions experts, and delivery experts, working on innovative projects. The purpose is to break the barriers of the functional departments in order to form a set of project-centric operation modes, where the decision-making power is granted to the first-line team, while the company only plays the role of supervision and guarantee. After the first-line teams discover strategic opportunities, Huawei gives them timely, effective support, including advanced equipment and high-quality resources, so that the competitive capabilities of the overall company can be greatly enhanced.

**Open innovation and cooperation.** Open innovation is a means of saving resources, enhancing competitiveness, and shortening the product development cycle, which requires widely building cooperative relationships with customers, suppliers, collaborators, competitors, regulators, and other players. In 2013, the open innovation center of Haier officially put the Haier Open Partnership Ecosystem (HOPE) on line, which is a network platform for Haier to interact with global partners and to seek excellent solutions. It combines the internal R&D departments, engineers, and innovative staff, external research institutions, universities, personal technical experts (professors, scholars, students, etc.), geek teams, ventures, venture capital funds, and so on. Through the sharing of knowledge and resources with global partners, HOPE creates a global interactive community for innovation. Also, Haier has established the mechanism of sharing its market value with its partners, including the construction of a patent pool, investment incubation, and joint laboratories. In Neusoft, open innovation is reflected in its constant search for technology and business models through its alliance and cooperation, as well as its active participation in the global division of labor. Huawei values cooperation with competitors in the strategic level, and has established joint laboratories with them, such as Texas Instruments, IBM, Intel, Siemens, and Symantec. Additionally, Huawei's internal R&D emphasizes borrowing technology, that is, Huawei tries to refer to or buy in mature technologies from others.

## 5. Discussions and Conclusions

### 5.1. Innovation Resilience from the Duality View

In Section 2, the literature review shows that stability and adaptability are the key elements of organizational resilience, and they are contradictory in the dimension of culture, leadership, and team. The case study provides insights into how resilient organizations cope with stability and adaptability. The cultural atmosphere, leadership strategy, and team structure together determine the innovation strategy of a company [66]. Changing an innovation strategy means reconfiguring all of these elements, which are the long-term accumulation of the organizational capacity, and thus are difficult to change in a short time [68]. Therefore, many companies choose to take only one single solution, namely either stability-oriented or adaptability-oriented activities.

If companies only engage in conventional management activities, focusing on rules, procedures, modularity, and standardization, they will never succeed in organizational change, and may fall into the pitfall of short-termism, when there are significant, disruptive trends occurring in the market they serve. Similarly, being obsessed with innovation of the technology and business model, organization may also go down into the innovation trap, when the competitive advantages lie in operational efficiency, due to the relatively stable business environment. Resilient organizations can simultaneously take both two

sides into account, by wisely designing management methods, rather than simply pursuing stability or adaptability, which enables them to cope with uncertainties and sustain long-term advantages.

Stability-oriented and adaptability-oriented activities are complementary rather than contradictory [52,55]. Conventional management activities are similar to a sports teams' home advantage, where the company finds it easy to obtain short-term success. Without the strong support of the senior leaders, the organizational resources will mostly flow into conventional management activities [46]. Therefore, the seniors leaders need to balance the regular and creative activities in order to find out the most beneficial resource allocation on the behalf of the whole organization [45,48]. To do that, managers often confuse how many resources should be allocated for stability-oriented activities and how many should be allocated for adaptability-oriented activities. Unfortunately, an optimal ratio does not exist either. As with the contingency theory [99], the answer depends on a firm's specific circumstance, as well as other factors, such as the speed of technological change, the degree of competition, market growth, and consumer demand.

### 5.2. Theoretical Implications

Environmentalism is evolving from "sustainability" to "resilience" [1], and the research of sustainable innovation should also shift to "resilience innovation". In reviewing the literature, we find that resilience as a key concept appears in interdisciplinary areas, but it has received little independent attention in the innovation context. Therefore, we pay attention to building the construct of innovation resilience, and identifying the key elements of it. The contribution of this study is twofold.

First, the findings contribute to uncertainty management of innovation in order to obtain a sustainable competitive advantage. We apply the organizational resilience theory to the domain of innovation management, and conceptualize innovation resilience as the capability to cope with the uncertainties concerned with innovation. Uncertainties are difficult to handle, because of the inability to predict and assess the likelihood of an event, lack of information to describe cause–effect relationships, and the unknown outcomes of decision-making [100,101]. Risk management is an important approach in order to manage the uncertainties concerned with innovation [102–104]. Traditional risk management has serious limitations, because its tools and methodologies are based on risk identification and statistical information, while the uncertainties that an organization faces are unpredictable or impossible to know before the fact [105,106]. To address this gap, the concept of innovation resilience is proposed from the duality view of stability and adaptability. The application of resilience theory to the domain of innovation management allows for a more effective approach managing the uncertainties in the innovation process [4].

Furthermore, our study also contributes to the question of how to simultaneously balance stability and adaptability. Prior literature shows that stability and adaptability are the two key elements of organizational resilience, and resilient organizations employ different strategies when coping with environmental uncertainties—some organizations emphasize stability-oriented activities, while others focus on adaptability-oriented activities [51,107]. We provide an analytical framework by connecting stability and adaptability to the dimensions of culture, leadership, and team. The empirical case study sheds some new light on how stability and adaptability are integrated in the three dimensions. From the duality view [52,55], our study shows that resilient organizations could embrace this paradox, and the integration of stability and adaptability ensures that autonomous innovation could be strictly controlled and enterprises could operate stably and adapt to changes at the same time. This study has investigated four resilient companies from different industry sectors within the China context, and has discovered what the common issues are that foster resilience in innovation processes. A set of 17 indicators have been identified for measuring innovation resilience through the grounded theory and case analyses. This set of indicators is intended to provide innovative organizations with an effective overview of the key capabilities that they must have so as to cope with uncertainties for long-term sustainability.



## 5.2. Practical Implication

Sustainable innovation is not a reachable end state; rather, it is a dynamic, evolving process [108]. A key capability underpinning sustainable innovation is therefore the capacity to survive, adapt, and flourish in the face of turbulent change and uncertainty. As the business environment becomes more complex and is rapidly changing, the level of uncertainty that confronts organizations increases. Uncertainty is an unmeasurable or truly unknown outcome [109]. The probability of risk outcome can be calculated from historical data, however, it may be not possible to quantify the uncertainties, which can produce a variety of unpredictable outcomes. In more radical and disruptive innovations, organizations have to deal with highly unique issues, and have to face more uncertainties that cannot be predicted. But, the ability of organizations to deal with these uncertainties can be identified. This paper develops a set of indicators that organizations can use in order to identify their strengths and weaknesses. With this set of indicators, they can answer questions such as “how resilient are we in the process of innovation management”, “does our level of innovation resilience meet our goals”, and “what could we do to improve capabilities to dealing with uncertainties?”. As such, cultivating the above indicators is fundamental in order to achieve a sustainable competitive advantage through innovation resilience.

## 5.3. Limitations and Opportunities for Further Research

This research has investigated resilient organizations in China, and their common characteristics and capabilities concerned with innovation are found. Future research is needed in order to test the global applicability of the elements of innovation resilience identified in this study. Therefore, a cross-cultural study should be conducted. This paper is also limited by the number of cases, and future studies may use more cases in order to enrich the indicators. In addition, researchers may develop questionnaires based on this set of indicators, conduct surveys in resilient companies, and use the exploratory factor analysis method to test these indicators' confidence. Companies require a scale that can be operated easily in order to investigate the resilience associated with innovation; thus, further work needs to be done so as to create a more standardized and mature model for measuring innovation resilience.

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