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Article

Effect of Environmental Turbulence on New Product Development: A Case of Serial Mediation of Strategic Flexibility and Bricolage in High-Tech Industries of Chengdu, China

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Abstract Few studies have examined the role of mediating mechanisms played by bricolage in the relationship between strategic flexibility and new product development, even though most of the studies view strategic flexibility as a capability to cope with environmental turbulence and promote product innovation. The bricolage approach embraces the resource-based understanding of the product development process as a concrete process of recombining resources in the process and exploring the mechanisms behind the bricolage approach. This study is the first of the kind that has examined the empirical effect of environmental turbulence on new product development through serial mediation of strategic flexibility and bricolage. Based on our results, environmental turbulence positively and significantly affects new product development through the serial mediation of strategic flexibility and bricolage. Bricolage is one of the mechanisms by which strategic flexibility may play a part in supporting product innovation. Our contribution to strategic flexibility research comes from examining the effect of strategic flexibility on bricolage and new product development from the point that environmental turbulence compels the high-tech industries to remain strategically flexible for their sustainability and growth. Besides providing new evidence on the relationship between environmental turbulence and product innovation, this research also provides new insight into the economic opportunity of new product development in transition economies such as China.

Keywords: Bricolage; Environmental Turbulence; High-Tech Industries**;** New Product Development; Strategic Flexibility

1. Introduction

In modern days the world depends on advanced levels of technology for sustainability and growth. However, the competition faced by high-tech industries has become cutthroat. The major reason for this is environmental turbulence (Arifiani et al., 2020). The term "environmental turbulence" refers to uncertainty and predictability due to the constant changes in consumers' demands and technologies, making the environment dynamic and volatile (Calantone et al., 2003). The two main dimensions of environmental turbulence are technical and market-driven (Danneels & Sethi, 2011). Technology development is turbulent due to the rapid innovation of new products and rapid technological production changes. There is constant change in the customer composition, and the market's demand is continuously changing in markets that are experiencing turbulence. The result will be creating new products designed to satisfy consumers' needs by targeting specific functions (Moorman & Miner, 1997). Quickly. As a result, it is necessary to update competitive strategies in product development and manufacturing processes accordingly, especially when faced with a constantly changing and uncertain market environment, as well as a constant flux in technological boundaries that result in constantly changing competitive strategies all the time (Evans, 1991). A few more factors that contribute to environmental turbulence are; change in demand, competitor's new product development,

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entry into a new market, a new variety of products, new price plans, and adoption of new technology.

Several arguments have been made that the turbulence of the environment catalysis strategic flexibility (Murphy & Seriki, 2021). The instabilities in the environment have put at risk the advantages that businesses have derived from their available resources and existing market segments. The creation of such a product will be achieved by bricolage activities, such as improvisations and recombination of resources, which will result in a significant reduction of the cost and time associated with the product development process to meet the consumers' needs (Wu et al., 2017). However higher level of bricolage requires the organizations to be strategically more flexible. Thus, it is becoming increasingly important for businesses, particularly those in the high-tech industries, to remain flexible with their resource use as turbulence in the business environment makes it increasingly difficult to change how they use their resources. This will decrease the efforts and expenses associated with switching over to use resources in alternative ways.

Secondly, firms seeking to maintain a competitive advantage in turbulent markets need to build strategic flexibility into every aspect of their management process, organizational structure, and development process. Therefore, strategic flexibility should be a major contributor to the firm's growth and success. It is essential to realize that higher levels of environmental turbulence enhance the strategic flexibility of organizations. Organizing resources is only possible when the organizations have a strong sense of strategic flexibility.

When it comes to product competition, strategic flexibility is crucial. As described by Sanchez (1995), strategic flexibility refers to the ability of an enterprise to coordinate its product creation resources and the flexibility of product creation resources themselves. Firms benefit from strategic flexibility by reworking their resources chain to respond quickly to changes in competitive conditions (Nadkarni & Herrmann, 2010; Combs et al., 2011). Combining strategic flexibility with firm performance leads to distinct innovation (Nadkarni & Narayanani, 2007). A flexible firm, for example, tends to expand internationally (Fisch & Zschoche, 2012) and perform better in the innovation of goods and services (Zhou & Wu, 2010; Li et al., 2010). Further, Yawson & Greiman (2017) discuss how strategic flexibility can analyze scenarios and apply them to human resources development and management (Yawson & Greiman 2017). In other words, in extensive studies, strategic flexibility is regarded as one of the critical abilities required for achieving competitive advantage (Dreyer & Gronhaug, 2004). In the transition period of a country's economy, being in the midst of a transition process makes it even more crucial to maintain the strategic flexibility necessary to deal with the resource constraints caused by technological change and volatile consumer demand.

In previous studies, multiple works have mainly focused on firm performance and the outcomes of strategic flexibility (Chen et al., 2017). Companies need to develop new products and innovate extremely well (Wei et al., 2014). In recent studies, strategic flexibility has been observed as an antecedent to creation (Li et al., 2010). Companies employ strategic flexibility in conjunction with resource redeployment and reconfiguration of operations routines, enhancing new product introduction (Worren et al., 2002; Kandemir & Acur, 2012) and speeding up response to complex dynamic environments. Recent studies have neglected to examine the influence of strategic flexibility on the development of new products. The literature on financial performance has overwhelmingly discussed it as an outcome process rather than as a process of assessment (Nadkarni & Herrmann, 2010), while competitive advantage has also been discussed primarily as an outcome process (Dereyer & Gronhaug, 2004; Chen et al., 2017), leaving the intermediate processes untouched. To achieve strategic flexibility, the organization has to have the organization’s capabilities as well (Zhou & Wu, 2010). Therefore, it's essential to uncover intermediate factors that allow new product development to occur strategically. Interestingly, existing research tends to ignore such elements.

The concept of bricolage should be examined as a mediating factor resulting from the above situation. According to Baker & Nelson (2005), bricolage is a process that combines

handy resources to create a new product. In many firms, bricolage improves resource constraints and brings product and process knowledge together with undervalued, slack, or otherwise discarded resources (Witell et al., 2017; Welter et al., 2016). This is because the flexibility of the strategic approach to a company's business model helps create bricolage, which is crucial for creating new products in turbulent times with limited resources and managing chaotic environments. Strategic flexibility is emphasized to create value to develop challenging assignments and new products with limited resources (Welter et al., 2016).

China provides a suitable environment for testing the research hypotheses in this paper due to its fast growth and dynamic and dysfunctional institutional environment. A significant change in institutional structure is underway in China, affecting the firm's formal and informal social systems (Peng, 2003). Firms in uncertain and dynamic environments will find widespread institutional transitions in emerging economies. In previous research, the antecedents of strategic flexibility in emerging economies have been explored, including CEO personality (Nadkarni & Herrmann, 2010), business ties to new product development alliances (Dai et al., 2018), and IT support (Chen et al., 2017). We have examined how environmental turbulence affects new product development and tested whether strategic flexibility and bricolage serially mediate the effect of environmental turbulence on the emergence of a new product.

The primary intention of the study is to make a significant contribution to both the existing scientific literature and the formation of new scientific knowledge by showing, empirically and theoretically, how strategic flexibility and bricolage mediate between environmental turbulence and new product development. The majority of the studies focusing on strategic flexibility's effects have been conducted in the context of market entry (Claussen et al., 2018), innovation (Li et al., 2010; Wei et al., 2014; Kato & Zhou, 2018), firm performance (Combs et al., 2011; Chen et al., 2017; Guo & Cao, 2014), energy efficiency (Schulze & Heidenreich, 2017) and competitive advantage (Nadkarni & Narayanani, 2007; Dreyer & Gronhaug, 2004). This study adds to the previous literature by determining the strategic flexibility and bricolage mediate the effects of environmental turbulence on new product development. Through Bricolage exercises, it is possible to understand the impact of strategic flexibility on developing a new product because it involves a particular procedure that must be followed to develop a new product. It is not only of importance to the literature on strategic flexibility (Brozovic, 2018), but the article also contributes to the existing body of knowledge on very similar topics as bricolage (Desa & Basu, 2013) and environmental turbulence (Danneels & Sethi, 2011).

The rest of the study has been organized as follows. Section 2 presents the research background and critically reviews the pertinent literature. Section 3 describes the data collection instrument, study sample, and the statistical methodology of data analysis. Section 4 presents the results of the analysis. The study's findings have been concluded, and the implications of the study have been discussed in section 5.

2. Research Background and Conceptual Framework Development

2.1. Strategic Flexibility

Flexibility in strategic planning refers to adjusting to a constantly changing environment by continually adjusting resources and strategic actions in response to the dynamic environment. Taking a resource-based view of Strategic Flexibility can be seen as a review of the company's efforts to use valuable resources to build a competitive edge (Sanchez, 1995). There are several ways in which a firm can achieve success in adapting to competitive threats and weathering the external pressures of the market and consumers. One means of doing this is by confidently redeploying and relocating resources and production processes in response to external challenges and threats and technological advances (Bock et al., 2012). Therefore, strategic flexibility can be defined as the flexible use of resources in developing new products. The practical application of these resources can increase the core competitiveness of a company in uncertain markets (Zhou & Wu, 2010;

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Eisenhardt & Martin, 2000). Expanding the resource for innovation is enhanced when the organization's strategy is flexible (Li et al., 2017). Thailand firms have a growing tendency to grasp strategic flexibility when dealing with the economic downturn (Grewal & Tansuha, 2001) and enter new markets in the US airline industry (Claussen et al., 2018). The ability to meet market demand is crucial. To provide these capabilities, we need to ensure that the workforce is flexible (Kato & Zhou, 2018), the supply chain is adjustable (Ko et al., 2018), and the manufacturing process is flexible (Jesus et al., 2018).

It is necessary to stress that strategic flexibility in reducing uncertainty consists of flexibility in resource allocation and coordination flexibility in the competitive marketplace. These are two dimensions of flexible resource management. The definition of resource flexibility should entail defining an effective range of products capable of being developed and manufactured using that resource (Zhou & Wu, 2010). When changing over to alternative resource use, making the process as short and cheap as possible (Sanchez, 1995; Sanchez & Heene, 1997). Accordingly, coordination flexibility is the ability to coordinate new product design deployments and create the resources necessary to adjust product strategies, facilitating reallocating resources effectively (Brozovic, 2018).

Strategic flexibility identifies market opportunities and dynamically deploys resources, creating new dominant logic in product competition. By utilizing resource coordination processes, flexible firms can fully use the available options in the busy market to efficiently coordinate their resources. For example, the new information system used to support information systems development can help SMEs build an efficient method to make quick decisions and enhance their ability to utilize market resources effectively (Levy & Powell, 1998; Hitt et al., 1998). The concept of strategic flexibility seeks to minimize the difficulties and costs associated with changing the resource base of an enterprise and coordinating its strategies (Ebben & Jonshon, 2005). The concept of this model is that enterprise managers can create new market opportunities by using advanced technologies in new product development (NPD) by redesigning, redeploying and redeploying the resource chain to create their brand-new products (Chen et al., 2017). In the focus of our discussion, strategic flexibility is predominantly described in terms of dynamic capabilities, core competencies, and a capability to innovate new products. Several empirical studies have been able to demonstrate that strategic flexibility has a significant impact on the amount of innovation that can be applied during the decision-making process, such that it allows for the identification of the variables that determine the energy efficiency of research and development processes (Schulze & Hiedenreich, 2017). They acquire new product families or grab attention from consumers (Kandemir & Acur, 2012; Brozovic, 2018). Strategic flexibility plays a crucial role in creating value and competing in the market effectively.

2.2. Bricolage

It is argued that bricolage explains differential firm behavior and outcomes when resource conditions are not as extreme as those outlined in his "create something from nothing" theory (Baker & Nalson, 2005). According to Halme et al. (2012), bricolage refers to fostering entrepreneurship within a large organization by combining scarce resources creatively. Bricolage is based on the scarcity of resources which is one of the basic assumptions (Welter et al., 2016). Bricolage, in other words, is the strategy of adapting to new problems and opportunities by applying combinations of handy resources, something that has become increasingly prominent in organizational theory (Duymedjian & Ruling, 2010; Fisher, 2012). Bricolage happens in the opportunity-formation process when opportunities are created by combining unrelated or underdeveloped resources. A Bricoleur's view on resource scarcity appears as both a problem and a possibility in the face of an uncertain world.

In addition, organizational researchers have found it beneficial to combine diverse literature and methods with bricolage frames to improve them. It is a form of bricolage that relies on reconfiguring and redeploying resources. It is essentially a process of

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refurbishing resources for different applications than they were initially conceived to serve. Product innovation from existing resources through recombination processes has been essential in driving product innovation (Baker & Nalson, 2005; Mair & Marti, 2009). Several studies have provided insights into how bricolage helps to alleviate concerns of resource constraints by enhancing improvisational behaviors within organizations and recombining the assets at hand (Tasavori et al., 2018).

In Bricolage, a focus is placed on repurposing resources in a new way to create a new entity. Thus, organizational capacities are antecedents of bricolage. They can help bricoleurs creatively combine and utilize available resources to achieve their creative objectives (Guo et al., 2016). Among them are combinations of capacities, absorptive capacities, and exploratory orientations. According to Desa (2012), firms confronted with non-supportive normative institutions are more likely to leverage resources to acquire rather than bricolage resources when the normative institutions that foster their development are supportive (Desa, 2012). There are times when firms face resource scarcity, and bricolage might be the answer. Employing external knowledge or generating creative ideas, bricolage might create imperfect solutions but good enough, adding value to existing resources (Andersen, 2008; Ferneley & Bell, 2006). Using the bricolage competencies, such as renewing resources when they are not available, improvising in the reallocation processes, and working with external partnerships, play an essential role in the innovation process. These capabilities impact service innovation outcomes (Witell et al., 2017). Knowledge transfer and knowledge protection (Krylova et al., 2016), speed and creativity of new-product development (Wu et al., 2017). Opportunity identification (An et al., 2018) and organization performance (Halme et al., 2012). Using collages, new products and services can be developed from subjective knowledge. This can open up several possibilities and contribute to identifying entrepreneurship opportunities and satisfying unique market demands.

2.3. Environmental turbulence and strategic flexibility

Few studies have examined the relationship between environmental turbulence and strategic flexibility. And, most of those have determined the correlation between environmental turbulence and strategic flexibility. However, the following studies have discussed how environmental turbulence may have a causal effect on strategic flexibility, particularly in high-tech industries. Keeping a competitive advantage in a turbulent market requires strategic flexibility, which is one type of dynamic core capability (Meng et al., 2020). Thus, turbulence within the environment enhances strategic flexibility and creates value. Moorman & Miner (1997) say that due to the constantly changing competitive environment in the science and technology sector, firms are forced to continuously change strategies in product creation and manufacturing processes as a result of an uncertain and innovative environment. The ability to utilize improvisation, make do with low-cost resources at hand, and design innovative products without planning or prior preparation is enabled by the strategic flexibility that serves as a fundamental principle for coordinating various resources, (Li, et al., 2017).

Zhou & Wu (2010) say that flexible strategies enable firms to maintain a competitive advantage in a turbulent market by designing flexible management systems and organizational structures. In a dynamic and turbulent environment, opportunities for innovation are greater because of the constant reconfiguring that takes place. Strategic resources can be combined in new ways to produce something never seen before. Claussen (2018) narrated that firms thrive in turbulent and dynamic environments with strategic flexibility. It is these uncertain environments that provide a fertile ground for competitive advantage. Based on the above literature following hypothesis has been drawn:

Hypothesis 1 (H1): Environmental turbulence positively impacts strategic flexibility.

2.4. Strategic Flexibility and Bricolage

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According to various theories, a company's bricolage strategies are greatly influenced by its ability to redistribute and reconfigure its resources and produce new products quickly. Research on resource-based theory suggests that how strategic actions are used to leverage resources affects the competitive advantages of firms (Combs et al., 2011). Flexible plans emphasize the flexible utilization of resources and re-define product development processes to take advantage of improvisation and bricolage (Dai et al., 2018), which increases the chances of these two outcomes. Flexible resources allow the company to adapt to changes in the way resources are deployed and apply those resources to various products for manufacture and distribution (Sanchez, 1995). In this setting, entrepreneurs had the opportunity to utilize scarce resources through bricolage activity to satisfy the environment's constraints (Salunke et al., 2013).

When it comes to coordinating the mobilization of production resources, strategic flexibility can consist of reconfiguring the product strategy, reconfiguring the chain of production resources, or redeploying production resources effectively. The (Resource-Based View) RBV logic assumes that firms can maximize resources by optimizing their engagement and pursuing a satisfying outcome when creating products. Our ability to utilize resources more effectively and coordinate more effectively can be increased to reduce the cost and difficulty involved in switching between the various resources. This method reduces the cost of reallocating low-cost resources within an organization more dynamically and efficiently. These low-cost resources are at hand to assist in performing the assigned functions and functions within the company. To achieve high efficiency and cost-effectiveness in capturing different resources and restructuring the supply chain (Tao et al., 2020), enterprises must engage in greater bricolage levels.

Companies with strategic flexibility have overlapping resources or redundant resource utilization, whereas firms with limited flexibility lack such efficiencies. Therefore, the finding that firms with a high level of strategic flexibility have overlapping or redundant resources is explained by an increase in bricolage activity. Many companies face shortages of resources regularly, and as a result, they try to develop new solutions through bricolage. Conversely, bricolage also allows firms to innovate and create a form of value creation. The flexibility of a company's strategy is an excellent advantage for the company as this allows it to make the most of internal and external sources of resources and capabilities (Sanchez, 1997), which has the effect of increasing the return on value creation achieved through a combination of activities (Brozovic, 2018). Strategic flexibility helps firms attract resources and capabilities both inside and outside the organization (Sanchez & Heene 1997), increasing the likelihood of value creation via bricolage activity and enhancing value creation (Brozovic, 2018). In conclusion to these arguments and those given in 2.2 following hypotheses have been drawn:

Hypothesis 2 (H2): Strategic flexibility has a positive impact on bricolage.

Hypothesis 3 (H3): Strategic flexibility mediates the effect of environmental turbulence on bricolage.

2.5. Bricolage and New Product Development

It has been suggested that entrepreneurs use the bricolage framework to generate new solutions to problems in response to the perceived scarcity of resources (Welter et al., 2016; Halme et al., 2012). Bricolage generates opportunity-formation that relies on improvisation, combinative skills, communication skills, and organizational capability to develop. Therefore, bricolage plays a vital role in influencing the outcomes of a firm. Bricolage has been studied to mobilize and integrate resources, use available resources, and coordinate different activities within the bottom-up process of developing a new product (Halme et al., 2012). Bricolage initiates new product development pathways by using everything you have at home to discover the surroundings and related opportunities (Suire, 2019). In their study, Wu & Liu (2022) showed that organizations could use bricolage to innovate green products positively, but the effects depend on the participation of various stakeholders. The quality of a product can be improved by an adequate understanding of

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the product and practical testing of the product concept, which gives a clear picture of the product and provides insights into the product development. The productivity of bricolage can be improved by using existing networks to generate product ideas and create new materials that can be used with readily available resources (Fisher, 2012).

By combining new and old resources, bricolage merges materials, concepts, and human input to create unique and meaningful results. It is known that the process of recombination and redeployment of resources is one of the main drivers of new inventions because it is a significant part of innovation (Wu et al., 2017). Senyard et al. (2014) argued that bricolage provides a crucial path to achieve innovation for new resource-constrained firms by combining the available resources to solve new problems and exploit new opportunities. Senyard et al. (2014) propose that such recombination of elements can lead to innovative products and other innovative outcomes, which are vital to bringing in innovation and products. There is a shift in how companies combine low-cost resources and overcome challenges related to resource scarcity due to new opportunities and challenges that are becoming prevalent. Due to this reason, enterprises that cultivate bricolage will likely develop more innovative solutions than those that don't.

The concept of improvisation, or creative problem solving, is connected to bricolage, and it has emerged as an essential organization competency (Vera & Crossan, 2005). By improving one's imagination and creative skills, one can develop new products and solutions that consumers appreciate (Du et al., 2019). Several studies confirmed that improvisation leads to improved organization scalability when new products are designed by teams using external and internal information about the market (Kyriakopoulos, 2011). Taking advantage of the bricolage concept, then, teams of employees can demonstrate incremental innovation capabilities by recombining and reusing resources for new purposes and applications, thereby providing them with a competitive advantage (Liu et al., 2018; Suarez & Montes, 2019). Bricolage provides an opportunity to drive the discovery of new products from existing resources, and the process has the potential to drive product innovation (Baker & Nalson, 2005; Baker et al., 2003). When we are talking about the use of innovative ideas and the allocation of resources within a new methodology, it is essential to note that, in this context, we are talking about the utilization of essential resources, such as social capital and innovative ideas (Boxenboum & Linda, 2011). The act of bricolage thus creates a new destiny and a means of developing new products (Wu et al., 2017).

Additionally, by identifying and taking advantage of opportunities for entrepreneurship, bricolage is also a driver of corporate entrepreneurship by driving the choice of entrepreneurial activities such as the reconfiguration of manufacturing resources and the development of new products. The notion of bricolage is described by Baker & Nelson (2005) as the process of using resources that are handy to handle new problems or opportunities (Baker & Nalson, 2005). Making do means we are more inclined to take proactive measures to respond to challenges and opportunities rather than delay in finding a solution when we have handy resources, which illustrates that it is sometimes possible to achieve notable, unexpected results through active and collaborative engagement that can lead to astounding results (Desa & Basu, 2013). Based upon the above literature review and given in 2.3 and 2.4 following hypotheses have been drawn:

Hypothesis 4 (H3): Bricolage positively affects new product development.

Hypothesis 5 (H5): Bricolage mediates the effect of strategic flexibility on new product development.

Hypothesis 6 (H6): Strategic flexibility and bricolage serially mediate the effect of environmental turbulence on new product development.

Considering all of the hypotheses as drawn above based on a rigorous literature review, a summary of the relationships among environmental turbulence, strategic flexibility, bricolage, and new product development is summarised in Figure 1. The model summarises the various relationships between strategic flexibility, environmental instability, bricolage, and new product development. To test the stated hypotheses, environmental turbulence has been used as an independent variable, strategic flexibility and bricolage,

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respectively, have been used as the first level and second level mediating variables, and new product development has been used as the dependent variable. As environmental turbulence increases, its effects are likely to be mediated by strategical flexibility and bricolage on new product development. Direct mediation of strategic flexibility between environmental turbulence and new product development and of bricolage between environmental turbulence and new product development have also been tested in this study based on relationships among these variables reported by previous literature.

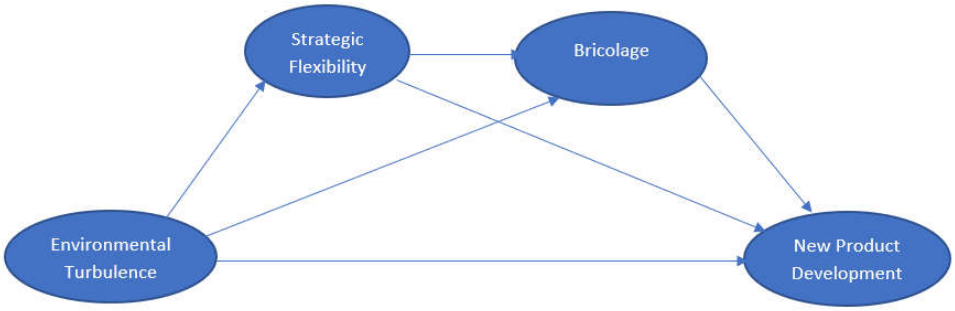

Figure 1. Theoretical Framework.

3. Methodology: Data Collection and Analysis

3.1. Data:

With many economic, commercial, cultural, transportation, and communication centers, Chengdu has become one of China's most important economic, financial, and commercial centers. In addition to the automobile, pharmaceutical, food, and information technology industries, its economy is very diverse. There are 270 Fortune 500 companies with branches in Chengdu; Chengdu also hosts 14 consulates (The Telegraph, 2019). To conduct this study, a five-point Likert scale structured questionnaire adapted from Meng, Lei, Jiao, and Tao (2020) was distributed among CEOs, CMOs and General Managers of 425 high-tech industries situated in Chengdu, including information technology, machine manufacturing, electronic, communication equipment, and pharmaceutical companies. Constructs used in this study have been measured using 4 items for Environmental Turbulence (ET), 5 items for Strategic Flexibility (SF), 4 items for Bricolage (BR) and 5 items for New Product Development (NPD), as shown in Table IV. We received 307 useable questionnaires out of 425 distributed questionnaires as mentioned above, with a response rate of 72 percent. The average age of the companies whose data have been used in this study is 8.5 years. The average number of employees working in these companies is 175, varying from 82 to 515. The percentage of the information technology, machine manufacturing, electronic, communication equipment, and pharmaceutical companies included in the sample is 31.9, 24.1, 16.9, 16.4 and 10.7 respectively.

3.2. Analysis:

Cronbach's Alpha was used to determine the reliability of the data. To identify factors within each construct and assess the divergent and convergent validity of each construct, Principal Component Analysis with varimax rotation was conducted. In order to estimate the mediation model as proposed in the theoretical framework serial mediation analysis using Process Macro developed by Hayes and Preacher (2014) has been employed.

4. Results of the Analysis:

Cronbach's Alpha values are shown in Table 1 for each construct. Hinton et al. (2004) cite four reliability cut-off points: excellent reliability (0.90 and above), high reliability

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(0.70–0.90), moderate reliability (0.50–0.70), and low reliability (0.50 and below). Among the constructs in the sample, Cronbach's alpha values range from 0.83 to 0.86, which indicates a high level of reliability: Environmental Turbulence (alpha = 0.83), Strategic Flexibility (alpha = 0.85), Bricolage (alpha = 0.85), and New Product Development (alpha = 0.86). This indicates that each construct has an internal consistency, as indicated by the high Cronbach's alpha value. Additionally, items within each construct measure the same content. Cronbach's value measures the reliability of measuring a construct, which is greater the higher the Cronbach's alpha value.

Table 1. Reliability of Measurements.

Constructs	Valid N	Number of items	Cronbach's alpha
Environmental Turbulence	303	04	0.83
Strategic Flexibility	299	05	0.85
Bricolage	302	04	0.85
New Product Development	303	05	0.86

Using the PCA method with varimax rotation, factor analysis was performed to check the construct validity, which includes both of the convergent validity and discriminant validity. Tables 2, 3 and 4 present the results of PCA. To determine whether the data are adequate for factor analysis, we used KMO's sampling adequacy test and Bartlett's sphericity test. Sphericity refers to the orthogonality of a construct's components, while sampling adequacy measures the connection between variables. According to Hinton et al. (2004), these two tests can be used to determine whether factor analysis is worthwhile to pursue. Factor analysis parses the data from many items into an uncorrelated set of factors that is easier to understand. KMO indicates the suitability of factor analysis based on sampling adequacy. A KMO value varies between 0 and 1. Values above 0.9 are superb, those between 0.8 and 0.9 are great, and those above 0.7 are mediocre (Hutcheson & Sofroniou, 1999). Based on the study results (Table 2), the KMO values for the four constructs range from 0.797 to 0.864, which is well above the recommended threshold of 0.60. In this case, it would be worthwhile to perform a factor analysis.

In Bartlett's sphericity test, a construct's items are analyzed to determine if there is any significant relationship between them. The null hypothesis of Bartlett's test assumes that no correlation exists among the items. It confirms the significance of a relationship between variables when the p-value is less than 0.05. Table 2 shows that all constructs have a p-value of less than 0.001, rejecting the null hypothesis of no relationship. Therefore, we can continue with the factor analysis.

Table 2. KMO and Bartlett's test.

Constructs	Items	KMO Values	Bartlett's Test Values (Chi-square)	P Values of Chi-square
Environmental Turbulence	04	0.797	437.738	.000
Strategic Flexibility	05	0.860	569.574	.000
Bricolage	04	0.802	501.430	.000
New Product Development	05	0.864	598.517	.000

Hinton et al. (2004) suggested that the components of a construct with an eigenvalue greater than 1 are considered the principal components and are used to proceed with the analysis. All eigenvalues and variances of the constructs explained by the principal components are shown in Table 3. Using the PCA extraction method, only one principal component was extracted from each of the four constructs: Environmental Turbulence (66.205% variance of the four items is explained), Strategic Flexibility (62.392% variance of the five items is explained), Bricolage (68.801% variance of the four items is explained), and New Product Development (63.377% variance of the five items is explained).

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Table 3. Eigenvalues and Total Variance Explained.

Construct	Components	Initial eigenvalues		
		Total	% of variance explained	Cumulative % of variance explained
Environmental Turbulence	**Comp 1**	2.648	66.205	66.205
Strategic Flexibility	**Comp 1**	3.120	62.392	62.392
Bricolage	**Comp 1**	2.752	68.801	68.801
New Product Development	**Comp 1**	3.169	63.377	63.377

As per Straub et al. (2004), the factor loadings for all items should be greater than 0,40, and no cross-loading of items should exceed 0.40. Table 4 demonstrates that all related items are loaded on just one factor, with factor loadings ranging from 0.748 to 0.849 for all constructs studied. These results establish that the measured constructs being studied are valid. There is both discriminant validity (items that load on extracted factors have eigenvalues of at least 1 and no cross-loading above 0.40) and convergent validity (items that load on extracted factors have eigenvalues of at least 1 and all loadings over 0.40) in the construct validity. As a result, the data collected from the instrument are valid.

Table 4. Descriptive Statistics and Factor Loadings.

Variables	Mean	Std. Dev.	Factor Loading
Environmental Turbulence			
This industry is experiencing rapid technological change.	2.9346	1.27098	0.843
Technological advancement creates more opportunities in the industry.	2.9085	1.23532	0.798
Customer preferences about the products we are dealing with don't change rapidly over the time.	2.8497	1.26632	0.797
New customers are being witnessed demanding our goods and services.	2.9641	1.31648	0.816
Strategic Flexibility			
A resource can be put to a wide range of alternative purposes.	2.9639	1.32363	0.820
It is expensive and difficult to switch from one use to another of a resource.	2.9085	1.26159	0.748
It takes little time to switch to another use of a resource.	2.9770	1.30389	0.784
Reconfiguration of the chain of resources the firm can rely upon to develop, manufacture, and deliver its intended products to the targeted markets are based on environmental changes.	2.8918	1.28942	0.815
Support the firm's product strategy by implementing organizational structures.	2.9052	1.28325	0.780
Bricolage			
To meet new challenges, we use existing resources and other inexpensive resources we have at our disposal.	2.8590	1.27080	0.841
For new operations, we combine resources that are available.	2.9412	1.31191	0.849
To tackle new challenges, we put our existing resources together into workable solutions.	2.8922	1.30753	0.841
As we respond to a new challenge, we employ any resource that appears useful.	2.8889	1.26260	0.785
New Product Development			
Introducing new products as quickly as possible.	2.9346	1.28126	0.803
Unlike our competitors, we have advanced production facilities.	2.9316	1.31552	0.794
The market reaction to our product innovations is better than that of our competitors.	2.9020	1.32450	0.797
All of the products we make are technologically advanced.	2.9216	1.29326	0.799
We are more successful at innovation than our competitors.	2.8758	1.32724	0.788

Table 5 contains the results of three regression models. These results show a significant positive effect of ET (ß = 0.81, p <0.001) on SF, significant positive effects of ET (ß = 0.514, p <0.001) and of SF (ß = 0.40, p <0.001) on BR and significant positive effects of ET (ß = 0.34, p <0.001), SF (ß = 0.42, p <0.001) and of BR (ß = 0.20, p <0.001) on NPD.

Table 5. Regression Analysis.

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Model	Dependent Variable	Independent Variable/s	Slope Coefficient	Necessary Statistics
1	SF	ET	0.81* (23.31)	R^2=0.66 F-Stat=543.15 Sig.(F-Stat) = 0.00
2	BR	ET	0.514* (10.61)	R^2=0.77 F-Stat=475.49 Sig.(F-Stat) = 0.00
		SF	0.40* (8.37)	
3	NPD	ET	0.34* (6.78)	R^2=0.77 F-Stat=475.49 Sig.(F-Stat) = 0.00
		SF	0.42* (8.94)	
		BR	0.20* (3.74)	

Note: * represents significance level at less than 1%.

Table 6 contains the result of the total effect of ET (ß = 0.85, p <0.001) on NPD, which is positive and significant at less than a 1% significance level. The total effect model represents the sum of the direct and indirect effects of the independent variable on the dependent variable.

Table 6. Total Effect Model.

Dependent Variable	Independent Variable/s	Slope Coefficient	Necessary Statistics
NPD	ET	0.85* (27.50)	R^2=0.73 F-Stat=756.26 Sig.(F-Stat) = 0.00

Note: * represents significance level at less than 1%.

Table 7 contains the result of the direct and indirect effects of ET on NPD. The direct effect shows the extent an independent variable directly affects the dependent variable in the presence of mediating variables in a model but not through the mediating variables. The first model in the table shows that the direct effect of ET (ß = 0.34, LLCI>0, ULCI>0) on NPD is positive and significant. The second model of Table VII shows the indirect effects of ET on NPD. The indirect effect is the extent an independent variable affects the dependent variable through the mediating variables. The total indirect effect of ET (ß = 0.51, LLCI>0, ULCI>0) on NPD is positive and statistically significant. It shows that one unit improvement in Environmental Turbulence causes an improvement of 0.51 units in New Product Development through Strategic Flexibility and Bricolage. The indirect effect of ET (ß = 0.34, LLCI>0, ULCI>0) on NPD through SF is also positive and statistically significant. It shows that one unit improvement in Environmental Turbulence causes an improvement of 0.34 units in New Product Development through Strategic Flexibility. Similarly, the indirect effect of ET (ß = 0.10, LLCI>0, ULCI>0) on NPD through BR and serial indirect effect of ET (ß = 0.06, LLCI>0, ULCI>0) on NPD through SF and BR are positive and statistically significant.

Table 7. Direct and Indirect Effects Models.

Model	Description of the Model	Slope Coefficient	LLCI	ULCI
Direct Effect	Direct Effect of ET on NPD in the Presence of Mediating Variables	0.34	0.24	0.44
Indirect Effect	Total Indirect Effect of ET on NPD	0.51	0.38	0.65
	Indirect Effect of ET on NPD through SF	0.34	0.24	0.45
	Indirect Effect of ET on NPD through BR	0.10	0.02	0.18
	Indirect Effect of ET on NPD through SF and BR	0.06	0.01	0.12

5. Discussion and Conclusion:

The present study has determined the effect of environmental turbulence on the new product development through the serial mediating effects of strategic flexibility and bricolage in the case of high-tech industries in Chengdu, China. The companies that have been surveyed for this study belong to the information technology, machine manufacturing, electronic, communication equipment, and pharmaceutical industries. All of the surveyed industries face a high level of environmental turbulence compared to non-high-tech industries. A higher level of environmental turbulence compels the companies to be more strategically flexible for their sustainability and future growth. Strategical flexibility leads to a higher level of bricolage, leading to a higher level of new product development. The findings of this study reveal that environmental turbulence not only directly creates opportunities for new product development, but it also creates opportunities for new product development through strategic flexibility and bricolage. The serial mediation of strategic flexibility and bricolage between environmental turbulence and new product development has been found to be positive and statistically significant.

In this field, essential contributions can be made relating to the growth of strategic flexibility in an uncertain environment and the development of new products. One of the contributions is that the theory of strategic flexibility has been connected to the literature on new product development. Strategic flexibility is well known for its positive effect on new product development for a business and its financial performance (Zhou & Wu, 2010; Dibrell, 2014; Li et al., 2010). Previous research on the subject matter has overlooked the impact of environmental turbulence on new product development through the serial mediating effects of strategic flexibility and bricolage. According to this study, it is concluded that a significant role is played by environmental turbulence through strategic flexibility and bricolage in the development of new products.

The findings of the study imply that environmental turbulence should not be considered a threat by the high-tech industries, but it should be treated as an opportunity for new product development. For this purpose, strategic flexibility is highly recommended for the high-tech industries. Experiences of high-tech industries regarding the rapid technological change, varying customer preferences, and interest of new customers compel them to put the resources into alternative uses, overcome the expenses and difficulties and manage the time required for putting the resources in alternative uses, reconfigure the chain of resources according to the environmental changes, and revisit the organizational structure to support the product strategy. If the high-tech industries consider the environmental turbulence as an opportunity and they remain strategically flexible, it helps them meet new challenges through using existing resources and new inexpensive resources, which further creates opportunities for them to develop new products.

Therefore, based on the findings of this study, it has been observed that strategic flexibility enables the firm to quickly adjust to a turbulent and dynamic environment and gain benefits of new product development through bricolage. Taking full advantage of the uncertain climate, bricolage provides a competitive advantage that can add value to the company's bottom line.

The limitations of this study suggest areas for further research. To begin with, the cross-sectional design of the data in this study limits our ability to draw causal indications regarding strategic flexibility and bricolage from the results. It is believed that existing theory and empirical evidence support this study's research hypotheses. However, these findings will be more robust if longitudinal research using archival data is conducted in the future. Secondly, this research sample is limited to 307 companies from **Chengdu city, Sichuan**, China and the results of this study may not apply to the whole country and to the other countries. The question remains how well our results might be used in economies in other emerging markets where the economic climate is more dynamic and uncertain and experiencing rapid economic growth. As a result of the Chinese culture, which is dominated by a collectivist belief system, managers in China are likely to react similarly to uncertainty and environmental instability. Therefore, it is suggested that additional analysis should be carried out to compare the firms in individualistic cultures

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with the firms in collective cultures. It is hoped that future research will also examine the consequences of tactical flexibility for decision-making and planning processes.

References

An, W., Zhao, X., Cao, Z., Zhang, J. and Liu, H. (2018). 'How bricolage drives corporate entrepreneurship: The roles of opportunity identification and learning orientation'. *Journal of Product Innovation Management*, 35 , 49–65.

Andersen, O. J. (2008). 'A bottom-up perspective on innovations—Mobilizing knowledge and social capital through innovative processes of bricolage'. *Administration & Society*, 40, 54–78.

Arifiani, L., Prabowo, H., Furinto, A. and Kosasih, W. (2020). 'Responding to changes in environmental turbulence – A strategy to driving business growth in facing economic downturn'. *Circular Economy*, 10.5772/intechopen.95054

Baker, T., Miner, A. S. and Eesley, D. T. (2003). 'Improvising firms: bricolage, account giving and improvisational competencies in the founding process'. *Research Policy*. 32, 255–276.

Baker, T. and Nelson, R. E. (2005). 'Creating something from nothing: resource construction through entrepreneurial bricolage'. *Administrative Science Quarterly*, 50, 329–366.

Bock, A. J., Opsahl, T., George, G. and Gann, D. M. (2012). 'The effects of culture and structure on strategic flexibility during business model innovation'. *Journal of Management Studies*, 49, 279–305.

Boxenbaum, E. and Linda, R. (2011). 'New knowledge products as bricolage: metaphors and scripts in organizational theory'. *Academy of Management Review*. 36, 272–296.

Brozovic, D. (2018). 'Strategic flexibility: A review of the literature'. *International Journal of Management Reviews*, 20, 3–31.

Calantone, R., Garcia, R. and Droge, C. (2003). 'The effects of environmental turbulence on new product development strategy planning'. *Journal of Product Innovation Management*, 20, 90–103.

Chen, Y., Wang, Y. Nevo, S., Benitez, J. and Kou, G. (2017). 'Improving strategic flexibility with information technologies: Insights for firm performance in an emerging economy.' *Journal of Information Technology*, 32, 10–25.

Claussen, J., Essling, C. and Peukert, C. (2018). 'Demand variation, strategic flexibility and market entry: Evidence from the us airline industry'. *Strategic Management Journal*, 39, 2877–2898.

Combs, J. G., Ketchen, D. J., Ireland, D. R. and Webb, J. W. (2011). 'The role of resource flexibility in leveraging strategic resources', *Journal of Management Studies*, 48, 1098-1125.

Dai, Y., Goodale, J. C., Byun, G. and Ding, F. (2018). 'Strategic flexibility in new high-technology ventures'. *Journal of Management Studies*. 55, 265–94.

Danneels, E. and Sethi, R. (2011). 'New product exploration under environmental turbulence'. *Organization Science*, 22,1026–1039.

Desa, G. (2012). 'Resource mobilization in international social entrepreneurship: bricolage as a mechanism of institutional transformation'. *Entrepreneurship Theory & Practice*. 36, 727–751.

Desa, G. and Basu, S. (2013). 'Optimization or bricolage? Overcoming resource constraints in global social entrepreneurship'. *Strategic Entrepreneurship Journal*. 7, 26–49.

Dibrell, C., Craig, J. B. and Neubaum, D. O. (2014). 'Linking the formal strategic planning process, planning flexibility, and innovativeness to firm performance'. *Journal of Business Research*, 67, 2000–2007.

Dreyer, B. and Gronhaug, K. (2004). 'Uncertainty, flexibility, and sustained competitive advantage'. *Journal of Business Research*, 57, 484–494.

Du, W. D., Wu, J., Liu, S. and Hackney, R. A. (2019). 'Effective organizational improvisation in information systems development: insights from the tencent messaging system development'. *Information & Management*.56, 614–624.

Duymedjian, R. and Ruling, C. (2010). 'Towards a foundation of bricolage in organization and management theory'. *Organization Studies*, 31, 133–151.

Ebben, J. J. and Johnson, A. C. (2005). 'Efficiency, flexibility, or both? Evidence linking strategy to performance in small firms'. *Strategic Management Journal*, 26, 1249–1259.

Eisenhardt, K. M. and Martin, J. A. (2000). 'Dynamic capabilities: what are they?'. *Strategic Management Journal*, 21, 1105–1121.

Evans, J.S. (1991). 'Strategic flexibility for high technology manoeuvres: a conceptual framework'. *Journal of Management Studies*, 28, 69–89.

Ferneley, E. and Bell, F. (2006). 'Using bricolage to integrate business and information technology innovation in SMEs'. *Technovation*, 26, 232–41.

Fisch, J. H. and Zschoche, M. (2012). 'The role of operational flexibility in the expansion of international production net-works'. *Strategic Management Journal*, 33, 1540–1556.

Fisher, G. (2012). 'Effectuation, causation, and bricolage: a behavioral comparison of emerging theories in entrepreneurship research'. *Entrepreneurship Theory and Practice*, 36, 1019-1051.

Grewal, R. and Tansuhaj, P. (2001). 'Building organizational capabilities for managing economic crisis: the role of market orientation and strategic flexibility'. *Journal of Marketing*, 65, 67–80.

Guo, H. and Cao, Z. (2014). 'Strategic flexibility and SME performance in an emerging economy a contingency perspective'. *Journal of Organizational Change Management*, 27, 273–298.

Guo, H., Su, Z. and Ahlstrom, D. (2016). 'Business model innovation: the effects of exploratory orientation, opportunity recognition, and entrepreneurial bricolage in an emerging economy'. *Asia Pacific Journal of Management*, 33, 533–549.

Halme, M., Lindeman, S. and Linna, P. (2012). 'Innovation for inclusive business: Intrapreneurial bricolage in multinational corporations'. *Journal of Management Studies*, 49, 743-784.

Hayes, A. F., and Preacher, K. J. (2014). 'Statistical mediation analysis with a multicategorical independent variable'. *British Journal of Mathematical and Statistical Psychology, 67*(3), 451-470.

Hinton, P. R., Brownlow, C., McMurray, I. and Cozens, B. (2004). 'SPSS explained'. East Sussex, England: Routledge Inc.

Hitt, M. A., Keats, B. W. and Samuel, M. D. (1998). 'Navigating in the new competitive landscape: building strategic flexibility and competitive advantage in the 21st century'. *The Academy of Management Executive,* 12, 22–42.

Hutcheson, G. and Sofroniou, N. (1999). 'The Multivariate Social Scientist: Introductory Statistics Using Generalized Linear Models'. *Sage Publications Ltd*.

Jesus, S. M., Knoppen, D., Mondonca, and Tachizawa, E. (2018). 'Building manufacturing flexibility with strategic suppliers and contingent effect of product dynamism on customer satisfaction'. *Journal of Purchasing and Supply Management.* 24, 238–246.

Kandemir, D. and Acur, N. (2012). 'Examining proactive strategic decision-making flexibility in new product development'. *Journal of Product Innovation Management,* 29, 608–622.

Kato, M. and Zhou, H. (2018). 'Numerical labor flexibility and innovation outcomes of start-up firms: a panel data analysis'. *Technovation,* 69, 15–27.

Ko, W. W. J., Liu, G., Ngugi, I. K. and Chapleo, C. (2018). 'External supply chain flexibility and product innovation performance: a study of small- and medium-sized UK-based manufacturers'. *European Journal of Marketing,* 52, 1981–2004.

Krylova, K. O., Vera, D. and Crossan, M. (2016). 'Knowledge transfer in knowledge-intensive organizations: the crucial role of improvisation in transferring and protecting knowledge'. *Journal of Knowledge Management*, 20, 1045–1064

Kyriakopoulos, K. (2011). 'Improvisation in product innovation: the contingent role of market information sourcesand memory types'. *Organization Studies.* 32, 1051–1078.

Levy, M. and Powell, P. (1998). 'SME flexibility and the role of information systems'. *Small Business Economics,* 11, 183–196.

Li, Y., Li, P. P., Wang, H. and Ma, Y. (2017). 'How do resource structuring and strategic flexibility interact to shape radicalinnovation?'. *Journal of Product Innovation Management,* 34, 471–491.

Li, Y., Su, Z. and Liu, Y. (2010). 'Can strategic flexibility help firms profit from product innovation?'. *Technovation,* 30, 300–309.

Liu, Y., Lv, D., Ying, Y., Arndt, F. and Wei, J. (2018). 'Improvisation for innovation: the contingent role of resource andstructural factors in explaining innovation capability'. *Technovation*, 75, 32–41.

Mair, J. and Marti, I. (2009). 'Entrepreneurship in and around institutional voids: a case study from Bangladesh'. *Journal of Business Venturing*, 24, 419–435.

Meng, M., Lei, J., Jiao, J. and Tao, Q. (2020). 'How does strategic flexibility affect bricolage: The moderating role of environmental turbulence'. *PLoS ONE* 15(8): e0238030. https://doi.org/10.1371/journal.pone.0238030

Moorman, C. and Miner, A.S. (1997). 'The impact of organizational memory on new product performance and creativity'. *Journal of Marketing Research,* 34, 91–106.

Murphy, R. and Seriki, O. (2021). 'The impact of environmental turbulence on the strategic decision-making process in Irish quantity surveying (QS) professional service firms (PSFs)'. *Construction Management and Economics,* 39, 739-758.

Nadkarni, S. and Herrmann, P. (2010). 'CEO Personality, strategic flexibility, and firm performance: Thecase of the Indian business process outsourcing industry'. *Academy of Management Journal*, 53, 1050–73.

Nadkarni, S. and Narayanani, V.K. (2007). 'Strategic schemas, strategic flexibility, and firm performance: the moderating role of industry clock speed'. *Strategic Management Journal,* 28, 243–70.

Peng, M. W. (2003). 'Institutional transitions and strategic choices'. *Academy of Management Review,* 28, 275–296.

Salunke, S., Weerawardena, J. and McColl-Kennedy, J. R. (2013). 'Competing through service innovation: The role of bricolage and entrepreneurship in project-oriented firms'. *Journal of Business Research.* 66, 1085–1097.

Sanchez, R. (1995). 'Strategic flexibility in product competition'. *Strategic Management Journal*, 16, 135-159.

Sanchez, R. and Heene, A. (1997). 'Reinventing strategic management: new theory and practice for competence-based competition'. *European Management Journal,* 15, 303–317.

Schulze, M. and Heidenreich, S. (2017). 'Linking energy-related strategic flexibility and energy efficiency the mediating role of management control systems choice'. *Journal of Cleaner Production,* 140, 1504–1513.

Senyard, J., Baker, T., Steffens, P. and Davidsson, P. (2014). 'Bricolage as a path to innovativeness for resource-constrained new firms'. *Journal of Management Studies*, 31, 2011-230.

Straub, D., Boudreau, M. C. and Gefen, D. (2004). 'Validation guidelines for IS positivist research'. *Communications of the Association for Information Systems*, 13, 380–427.

Suarez, F. F. and Montes, J. S. (2019). 'An integrative perspective of organizational responses: routines, heuristics, andimprovisations in a mount everest expedition'. *Organization Science*, 30, 573–599.

Suire, R. (2019). 'Innovating by bricolage: how do firms diversify through knowledge interactions with fablabs?'.*Regional Studies,* 53, 939–950.

Tasavori, M., Kwong, C. and Pruthi, S. (2018). 'Resource bricolage and growth of product and market scope in social enterprises'. *Entrepreneurship and Regional Development*, 30, 336–361.

The Telegraph (2019). 'Multinationals flock to 'central hub' city Chengdu'. ISSN 0307-1235. Archived from the original on 11 January 2022.

Vera, D. and Crossan, M. (2005). 'Improvisation and innovative performance in teams'. *Organization Science.* 16, 203–24.

Wei, Z. Yi, Y. and Guo, H. (2014). 'Organizational learning ambidexterity, strategic flexibility, and new product development'. *Journal of Product Innovation Management*, 31, 832–847.

Welter, C., Mauer, R. and Wuebker, R. J. (2016). 'Bridging behavioral models and theoretical concepts: effectuation andbricolage in the opportunity creation framework'. *Strategic Entrepreneurship Journal*, 10, 5– 20.

Witell, L., Gebauer, H., Jaakkola, E., Hammedi, W., Patricio, L. and Perks, H. (2017). 'A bricolage perspective on serviceinnovation'. *Journal of Business Research*, 79, 290–298.

Worren, N., Moore, K. and Cardona, P. (2002). 'Modularity, strategic flexibility, and firm performance: a study of thehome appliance industry'. *Strategic Management Journal*, 23, 1123–1140.

Wu, L., Liu, H. and Zhang, J. (2017). 'Bricolage effects on new-product development speed and creativity: the moderating role of technological turbulence'. *Journal of Business Research*, 70, 127–35.

Wu, L. and Liu, H. (2022). 'How bricolage influences green management in high-polluting manufacturing firms: The role of stakeholder engagement' *Journal of Management Studies*, https://doi.org/10.1002/bse.3111

Yawson, R. M. and Greiman, B. C. (2017). 'Strategic flexibility analysis of agrifood nanotechnology skill needs identification'. *Technological Forecasting and Social Change*, 118, 184–194.

Zhou, K. Z. and Wu, F. (2010). 'Technological capability, strategic flexibility, and product innovation'. *Strategic Management Journal*, 31, 547–61.