

Innovation capability: a systematic review of the Chinese industry

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Abstract

Purpose – This systematic literature review aims to broaden the understanding of innovation capability. More specifically, we deepen comprehension of innovation capability by studying a major emerging country like the Chinese industry.

Design/methodology/approach – This study employs a systematic literature review (SLR) of 142 peer-reviewed scientific publications between 2004 and 2023.

Findings – The findings point to three central elements, which are: describing the evolution of the institutional lesson to promote the innovation capability in China, identifying the lessons used by firms to improve innovative activity and their performance and proposing a theoretical framework to understand the complexity of the process that generates the innovation capability in the Chinese industry.

Originality/value – This study is a pioneer in conducting a systematic review of innovation capability in a national or regional context. This study allows us to identify, characterize and analyze the capabilities that helped develop innovation capability in China to show the way to develop innovation capability in industrial firms in other emerging countries.

Keywords Innovation capability, Systematic review, Theoretical framework, Capabilities, China

Paper type Literature review

1. Introduction

Innovation capability refers to “the ability to continuously transform knowledge and ideas into new products, processes, and systems for the benefit of the firm and its stakeholders” (Lawson and Samson, 2001, p. 384). In this scenario, numerous academics have shown that innovation capability operates as a set of capabilities that impact the performance of firms (Ali *et al.*, 2020, Wang *et al.*, 2023). Thus, innovation capability is recognized as a meta-capability (Lawson and Samson, 2001) that facilitates the development of a firm’s sustained competitive advantage (Camisón and Villar-López, 2014).

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In recent decades, studies on innovation capability have ranged from the theoretical (Saunila and Ukko, 2012; Zawislak *et al.*, 2012) to the empirical (Guan and Ma, 2003; Yam *et al.*, 2004; Chen *et al.*, 2019; Liu *et al.*, 2023). Despite these advances, studying innovation capability is a complex task given the absence of theoretical limits and the breadth of the topic. In the literature, through systematic literature reviews (SLRs), attempts have been made to address this complexity. But these types of studies are still scarce; the few notable examples include those by Saunila (2020), Mendoza-Silva (2020), and Daronco *et al.* (2023). In the context of small and medium-sized enterprises (SMEs), Saunila (2020) proposes that innovation capability, such as process and output, affects firm performance, especially that of manufacturing SMEs. For his part, Mendoza-Silva (2020) classifies the dimensions and determinants of innovation capability into intra-organizational, inter-organizational, and managerial categories, while Daronco *et al.* (2023) propose a framework of the elements that impact and define propensity and innovation capability, including organizational context and the elements that develop its processes.

While these contributions are important for understanding innovation capability in different management and organizational settings, SLRs examining innovation capability in the context of a region or country are scarce. We believe that certain contexts contribute to the emergence and development of innovation capability. In other words, even though innovation capability is a matter of the firm's nature, its development also depends on the context in which the firm emerges and develops. This necessitates some systematic literature reviews to help understand this aspect. Thus, in the present article, we present a systematic literature review (SLR) of innovation capability in the Chinese industry in order to broaden our understanding of this capability in this context of undeniable international importance. According to the World Intellectual Property Organization (WIPO), China ranked 43rd in the Global Innovation Ranking 2010. However, by the latest report, published in 2022, the country had reached 11th place, surpassing countries such as Japan, Canada, and France. This rapid growth is the result of a sustained effort of more than four decades, where China, through a set of industrial and economic policies, knew how to adapt to global changes and firms. While the Chinese manufacturing firm took advantage of cognitive and technological transfer to strategically develop innovation capability and obtain competitive advantages.

This article differs from the other SLRs on innovation capability in three ways. First, this study helps to broaden the knowledge of innovation capability by analyzing an emerging country. Innovation capability tends to be analyzed in the context of developed countries; thus, a systematic review in the context of emerging countries constitutes an important and novel research topic. Second, by focusing on China, a leading innovator despite its emerging status, our article aims to identify key aspects of innovation capability in this country. Third, the study will serve as a guide for studying China's innovation capability development trajectory and thus provide lessons for other emerging countries to improve their innovation capability.

In addition to this introduction, the article is structured as follows. Section 2 introduces the research method. Section 3 describes the descriptive findings of the review. Section 4 presents and discusses the analysis of the results. Finally, Section 5 concludes with some final considerations.

2. Method

In this study, we seek to broaden understanding of innovation capability by identifying the factors that precede, shape, and result from the innovation capability of the Chinese industry. To this end, we carried out a three-step SRL based on the study by Tranfield *et al.* (2003). First of all, we carry out a scoping study to identify the relevant criteria for a general analytical framework and thus capture the relevant literature. Second, we located and selected the relevant literature on innovation capability in China using explicit (inclusion and exclusion) criteria. Finally, we analyzed the content of the articles in order to disseminate the findings of our review. For the analysis of the articles, a database was created, and relevant topics were

coded, which facilitated the analysis and the complete reading of the selected articles, which was carried out by the authors. The scoping study also allowed us to identify the specific topics to review in the article reading. These measures minimized the risk of subjectivity in the research process.

We use the SRL method because it allows us to follow a systematic, transparent, and reproducible process to identify scholarly literature on a defined topic or research question (Fish and Block, 2018); that is, it provides us with rigorous and systematic research procedures to minimize random errors when searching, selecting, critically evaluating and summarizing the results of previous studies (Daronco *et al.*, 2023).

Scoping study: First, we identified the key relevance criteria through a scoping study, thereby avoiding criticism of what we mean by “relevant” (Bouwmeester *et al.*, 2022). For the scoping study, we used articles selected mainly on the basis of the highest number of citations per year. This provided the relevant criteria.

The first search yielded a total of 79 articles that have more than 200 citations in Google Scholar. However, in order not to penalize recently published articles, we added 13 additional articles obtained from the number of standardized citations, which we defined as the quotient of the number of citations divided by the difference between 2021 and the year of publication of the article. Adding together the articles found in both stages, we arrived at 92 articles.

Among these 92 articles, we first selected the ten articles with the highest number of standardized citations. Five of the ten selected articles have been cited more than 200 times per year, while the other five were cited less frequently (but still more than 100 times per year). However, careful reading, analysis, and comparison of the articles showed that two were not directly related to our research topic, leaving us with a total of eight articles. Using these eight articles, we sought to develop a suitable foundation for our systematic review. In the end, we determined five criteria of relevance: research gap, objectives, dimensions, performance, and external factors (see Table 1).

Table 1 summarizes the five relevant criteria that emerged from our scoping study (first column). The scoping study was based on our knowledge at the start of our research; however, this allowed us to check and ensure that we did not miss any important criteria in our SLR.

Location and selection: After completion of the scoping study, we carried out a seven-step process in which articles were included or excluded at each stage according to predetermined criteria (Figure 1).

First, our initial search was limited to articles published in Scopus and Web of Science (WoS), since these are two major peer-reviewed indexing systems. We looked for articles related to innovation capability in China. However, because not all researchers use the same terms, we searched using several synonyms. We used the following query in Boolean expressions (“innovation capability” OR “innovation capabilities” OR “innovation capability” OR “innovation capabilities” OR “technological innovation capability” OR “technological innovation capabilities” OR “innovation capability business” OR “business innovation capabilities” OR “organizational innovation capability” OR “organizational innovation capabilities”) AND “China”) in the title, abstract, and keywords, for a search period up to June 2023. We used the entire sample available in the databases up to June 2023. A total of 1,060 and 355 articles were found in Scopus and WoS, respectively.

Second, we limited the search to the subject areas of Business, Management and Accounting and Economics, Econometrics, and Finance, excluding other fields such as Operational Research or Arts and Humanities, which resulted in 472 and 186 articles from Scopus and WoS, respectively. Third, only articles, editorials, and reviews are included in the analysis, reducing the number of articles to 392 in Scopus and keeping the number of articles in WoS unchanged. Fourth, we located all available items without duplicates, which resulted in 314 available items. Then, once we had the preliminary search results, as a fifth step we reviewed the titles, abstracts, and keywords for all available articles (without duplicates) and selected the relevant articles based on the exclusion criteria presented in Table 2.

Table 1. Relevance criteria

Relevance criteria	Description
<i>Research gap</i> Calantone et al. (2002) , Cavusgil et al. (2003) , Subramaniam and Youndt (2005) , Lin (2007) , Camisón and Villar-López (2014)	• Absence of empirical evidence on factors related to learning orientation, accumulation and use of knowledge, decentralization of workers, and leadership and its relationship with innovation capability • Lack of studies that capture the dynamic process of innovation capability; longitudinal data must be collected to explore the dynamic nature of innovation capability
<i>Objectives</i> Lawson and Samson (2001) , Calantone et al. (2002) , Romijn and Albaladejo (2002) , Cavusgil et al. (2003) , Subramaniam and Youndt (2005) , Lin (2007) , Camisón and Villar-López (2014) , Le and Lei (2019)	• Generate empirical evidence that can explain how firms improve their innovation capability • Examine how the influence of various factors, such as organizational, knowledge, and technological, lead to superior innovation capability • Investigate the relationship between innovation capability and firm performance
<i>Dimensions</i> Calantone et al. (2002) , Romijn and Albaladejo (2002) , Cavusgil et al. (2003)	• There is a range of factors that are understood as innovation capability factors. The literature identifies these as organizational learning, organizational innovation, tacit and explicit knowledge, individual factors, technological factors, human capital, social capital, and organizational capital • In general, the dimensions of innovation capability refer to skills related to managerial, intraorganizational, and interorganizational determinants
<i>Performance</i> Calantone et al. (2002) , Cavusgil et al. (2003) , Subramaniam and Youndt (2005) , Camisón and Villar-López (2014)	• The consequence of innovation capability is linked to the performance of the firm or its performance vis-a-vis the market. The latter allows improvement of market mechanisms • Measures of firm performance are: return on investment, return on assets, return on sales, overall profitability, and return on shareholders' funds
<i>External aspects</i> Lawson and Samson (2001) , Subramaniam and Youndt (2005) , Lin (2007) , Camisón and Villar-López (2014)	• The elements external to firms are mainly identified as collaboration between firms (social capital, knowledge reinforcement), knowledge sources (the internalization and socialization of knowledge) and external sources (technology management and client learning). These factors are important in reinforcing and generating the innovative capability process
Source(s): Prepared by authors	

At this stage, the authors classify the documents into three types: “Definitely relevant”, “Not relevant”, and “Unclear relevance at first.” Sixth, with the purpose of identifying false positives, the articles were read by the authors in full to ensure that they met the predefined criteria and to analyze the phenomenon of innovation capability. This step reduced the number of relevant documents to 137. Then, in the seventh stage, given the importance of innovation capability as a topic of study, we incorporated five book chapters that allowed us to trace the origins of innovation capability in China, as suggested by [Block and Fish \(2020\)](#). As a result, we reached a final sample of 142 study materials.

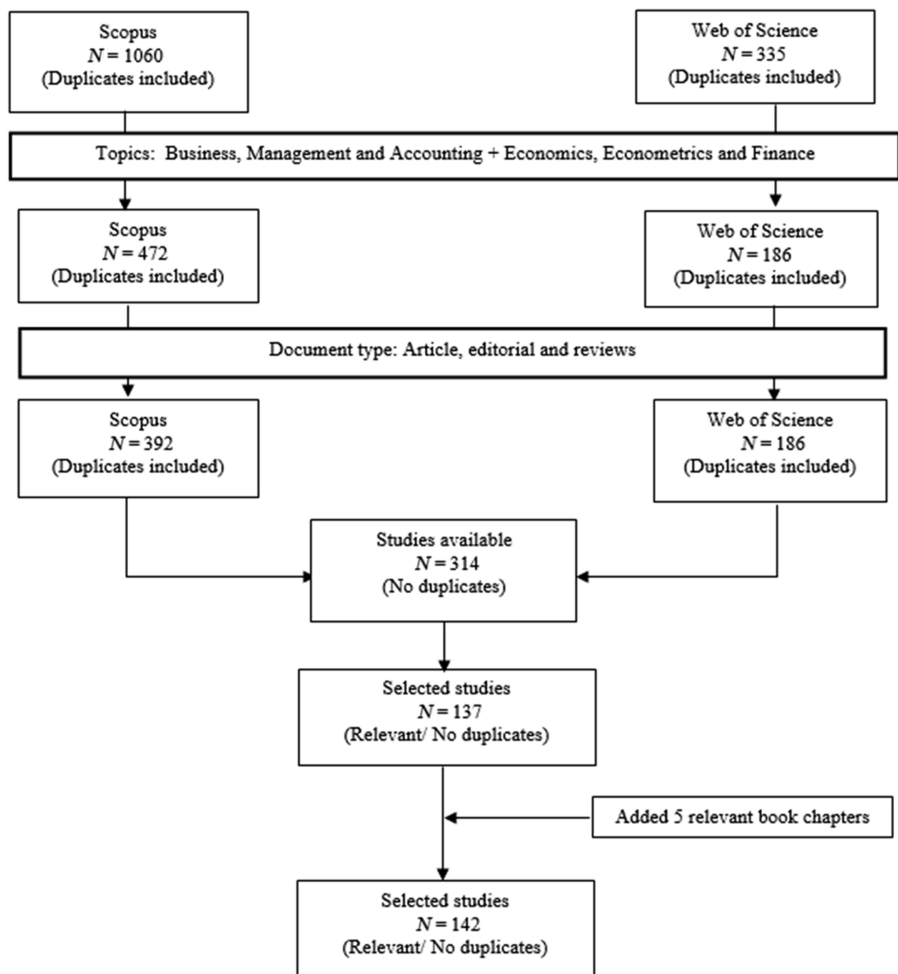


Figure 1. Literature selection process. **Source(s):** Prepared by authors

3. Descriptive results

Figure 2 shows the number of articles published in different years. The first article that met all the selection criteria for innovation capacity was published in 2004, and in the first decade of this new millennium (2004–2009), the average number of publications was 2 articles per year. Over the next decade, the average was 7.3 articles per year. Finally, from 2020 to July 2023, an average of 14 articles per year was reached. This shows the growth in the number of publications year by year and the increase in the debate on the innovation capability in the Chinese industry, so we expect this growth to continue in the coming years.

Of the articles published, the distribution according to the scientific method shows a great predominance of empirical articles, which represent 77.9% of the total. However, as another alternative method, it is followed by case studies, which represent 13.0%, showing the importance of the experiences of policies and practices carried out by industrial firms. Thirdly, we find the narrative articles that explain how the national innovation system and innovation in China evolve, which account for 7.6% of the total. Fourth, 1.5% of the articles review the

Table 2. Exclusion criteria

Exclusion criteria	Explanation
Articles that do not deal with innovation capability in Chinese industry	Articles that are of a generic nature regarding innovation or have no major implication or relationship with the area of innovation capability in Chinese industry
Studies on innovation capability that are not from China	Articles that are studied by Chinese researchers on innovation capability, but the empirical evidence shown is from another country
Belonging to the services, livestock, fishing, and agriculture sectors	Articles that focus on the services, livestock, fishing, and agriculture sectors. This criterion does not take into account industrial services such as telephone, cable and internet services, among others
Non-English language articles	Articles that are not written in English
Concept design articles	Because this study concentrates on innovation capability in China, concept design articles are excluded from consideration
Source(s): Prepared by authors	

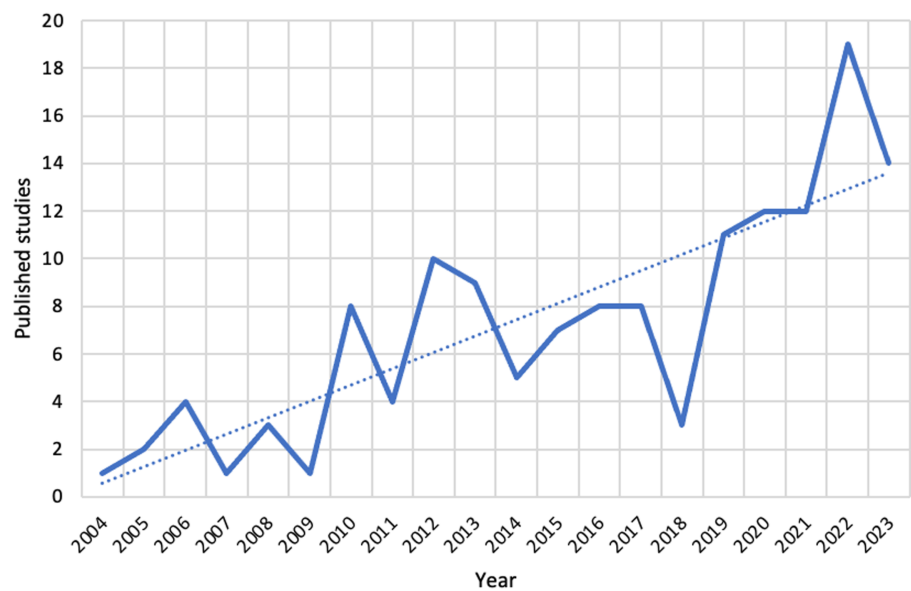


Figure 2. Evolution of published studies. Source(s): Prepared by authors

literature on innovation policies and innovation services in China to draw conclusions from other studies (see Figure 3). This is consistent with the distribution of the nature of the studies (Table 3), where quantitative studies predominate (107 articles). Representing to a lesser extent are qualitative studies and mixed methods are located to a lesser extent, with 10 and 8 articles, respectively.

There is a wide heterogeneity in the journals identified in this research, where the 137 articles are dispersed in 83 journals and 5 book chapters complement this study (Table 4). The main journals that publish on the innovation capability of Chinese industry are Chinese Management Studies (7 studies), Technological Forecasting and Social Change (7 studies), Journal of Science and Technology Policy in China, Technovation, European Journal of

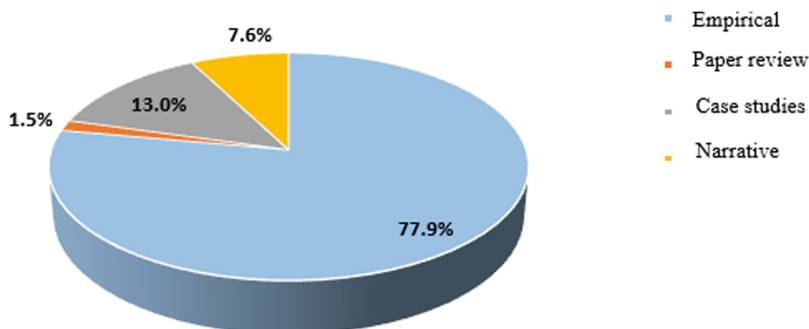


Figure 3. Distribution of articles according to scientific method. **Source(s):** Prepared by authors

Table 3. Distribution of nature of studies

Nature of studies	Number of studies
Quantitative	107
Qualitative	10
Mixed methods	8
Theoretical or descriptive	17
Source(s): Prepared by authors	

Table 4. Articles included by journal

Publication	Number of articles included
Chinese Management Studies	7
Technological Forecasting and Social Change	7
Journal of Science and Technology Policy in China	4
Technovation	4
European Journal of Innovation Management	4
International Journal of Technology Management	4
Asian Journal of Technology Innovation	4
International Journal of Innovation Management	4
Journal of Innovation and Knowledge	3
Industrial Marketing Management	3
Journal of Knowledge Management	3
International Journal of Production Research	3
Other journals with 2 or less articles (76 different)	87
Book's chapters	5
Source(s): Prepared by authors	

Innovation Management, International Journal of Technology Management, Asian Journal of Technology Innovation, International Journal of Innovation Management (each with 4 studies). The rest of the studies are found in journals such as Research Policy, Journal of Knowledge and Management, among others.

Another important result is that data collection for the studies comes from various sources (Figure 4). Surveys are the main source, representing 41.4%. In second place, but still an important source for research, are databases, accounting for 37.1%. The present article takes into account the sources of public information within the database because these are sources of a secondary nature. Third, 15.5% of the studies are multimethod, combining some or all of the other data sources described. Finally, 6.0%, in-depth interviews are a relevant source of first-hand information obtained directly from the managers or those in charge a firm’s R&D area.

4. Analysis of results

We analyze the results based on three categories: 1) the evolution of institutional lessons on innovation capability in China; 2) the identification of 5 capabilities that serve as lessons at the firm level on innovation capability in the Chinese industry; and 3) a framework for innovation capability.

4.1 Innovation capability in China: lessons at the institutional level

The development of the Chinese industry has not been easy, it has required an accumulated effort of more than 40 years. Before the 1980s, China had an economy based on the idea of central planning, where its industrial structure was characterized by the complete separation of research activities, education, universities, state agencies, and private firms (Fan, 2015). This changed when the Asian giant adopted a mentality towards the development of local innovation capability. In that sense, the policy of the Chinese government has been transformed considerably, and its evolution continues to this day. Indeed, China has gradually strengthened institutions and policies to promote science, technology, and innovation. In this logic, the innovation capability and economic development are evidence of the culmination of this strengthening process.

In the past four decades, the development of innovation capability in Chinese industry has depended on institutional changes that laid the foundation for the emergence of innovation capability. All this calls us to reflect and ask ourselves about the following: What are the

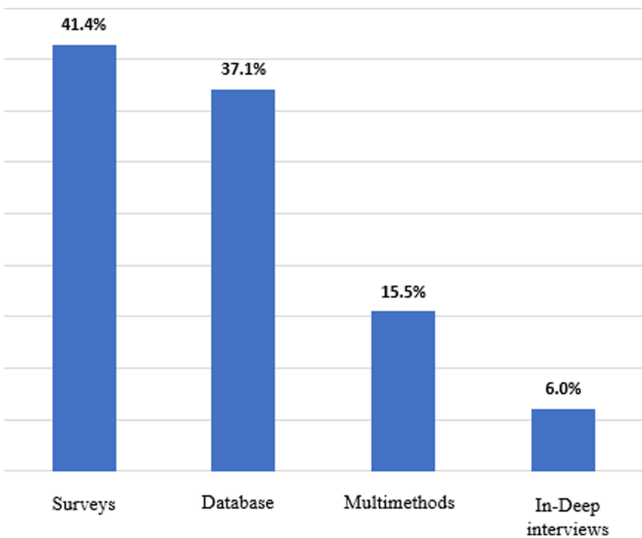


Figure 4. Data sources in the papers. Source(s): Prepared by authors

lessons at the institutional level that have boosted the innovation capability of Chinese industry firms? After a systematic review, we identify three stages. The first stage covers the period from 1978 to 1989; the second stage has its beginnings in 1990 and ends in 2000. The third and last stage is from 2001 to the present.

First stage (1978–1989) – As noted above, the development of innovation capability in Chinese industry stems from various institutional efforts that began in the 1970s. The central government of China, starting in 1978, implemented institutional and economic reforms that gave rise to the first actions in favor of innovation (Sawang *et al.*, 2017). The initial reform that gave rise to innovation capability appeared with the fifth five-year plan (1976–1980), where the government began an “open door” policy with the aim of attracting external technology for local industrial development. In this context, foreign direct investment and the transfer of foreign technology through imports and knowledge transfer (Fu and Xiong, 2011) constituted the first external measures, related to the firms’ environment, to develop innovation capability. Then, the seventh five-year plan (1986–1990) initiated decentralization policies whose purpose was to encourage private companies to contribute to national industrial development (Ghorbani *et al.*, 2023). At this stage, the state legitimized the role of science and technology in economic development and scientific freedom (Xue *et al.*, 2021), making use of market-oriented policies and economic transition that would allow sustained economic development (Sawang *et al.*, 2017). The objective of this period was to apply the results of research in science and technology to production in a broad and rapid way; make the most of scientific and technological personnel; and greatly enhance science and technology as the engine of the economy (Xue *et al.*, 2021). However, patent applications and collaborations were low, so innovation capability was still weak in firms (Sun and Cao, 2015). Therefore, using various institutional instruments, the government supported the development of innovation capability in relation to strategic projects or industries especially the study of mature technologies from advanced countries (Zhang *et al.*, 2021).

Second stage (1990–2000) – Beginning in 1990, the State Council of China promulgated the National Framework for Industrial Policies. This document establishes that, under the control and macroeconomic regulation of the state, industrial policies must be formulated to take full advantage of the fundamental role of the market in the allocation of resources. In addition, it introduced a series of policies for economic sectors, such as communication, construction, electronics, machinery, and petrochemicals, among others (Lin and Zhou, 2021), which were reflected in the eighth (1991–1995) and ninth (1996–2000) five-year plans. Unlike the basic innovation capability stage, where technology is imported for immediate use. At this stage, there was more attention towards a greater opening of different industries and the promotion of FDI foreign direct investment (Ghorbani *et al.*, 2023), which promoted that firms would adapt foreign technologies to their context and thus promote their innovative activity. In addition, the central government focused on promoting collaborative research by establishing joint units and cooperation platforms, business technology transfer centers, and university science parks, among other infrastructural projects (Sun and Cao, 2015). These policies inspired firms to develop their innovation capabilities and seek patent protection; that is, Chinese firms began to care more about their economic interests instead of simply following the administrative order. In addition, the government promoted the link between research institutes and firms. However, it was not until the late 1990s that firms began to accelerate investment in R&D and to shift from technology transfer-led growth to indigenous innovation-oriented growth (Fu and Xiong, 2011; Fu and Mu, 2014); for example, in the flat panel display (FDP) industry, technology transfers resulted in technology upgrades and imitation strategies in the context of technology-based substitution (Yu *et al.*, 2020). In that sense, this stage implemented relatively complex changes in foreign technologies, individually or through inter-organizational collaborations. Additionally, it implemented incipient R&D-based and non-R&D-based changes in the production process.

Third stage (2001–present) – At the beginning of the new millennium, the Chinese government introduced a series of measures to further foster collaboration between innovative

actors and encourage collaboration between firms, including the creation of a technology market (Sun and Cao, 2015). The R&D collaboration between firms and third-party agents is the factor that enables the transmission of information, skills, and technology (Shan and Jolly, 2013). In addition, at this stage, through the five-year plans, the state began to encourage Chinese firms to 走出去 (zouchuqu, meaning “go out”) for an aggressive pursuit of technological knowledge supported by insurance, legal support, and loans. low-cost (Ghorbani *et al.*, 2023) and emphasized local innovation in many industries, and required their firms to be globally competitive. So, the Chinese government encouraged foreign direct investment in R&D activities abroad to help its firms obtain foreign technologies and improve their technological capabilities (Gugler and Vanoli, 2015). Accordingly, the Guideline for the Medium-and Long- Term National Science and Technology Development Planning (2006–2020) was devised, which introduces the principles to support science and technology policies such as tax reduction, financial support, government procedures, intellectual property protection, and workforce strengthening (Xue *et al.*, 2021). Other forms of support consist of granting preferential policies, making subsidies or tax concessions for the improvement of new smart technology, or even transferring smart technology to companies (Yang *et al.*, 2022), or even promoting domestic demand where families purchase more products (Yu *et al.*, 2020). These measures were reinforced by China’s entry into the World Trade Organization (WTO) in 2001 (Fu and Xiong, 2011). In 2016, the State Council issued Suggestions to Promotion of Entrepreneurship and Mass Innovation aiming to facilitate science and technology innovation. Thanks to these guidelines, China hosted 17 specialized coworking spaces across the country, 3,600 science and technology business incubators, and 400 business accelerators; served 0.4 million start-ups; and created more than 1.8 million jobs (Xue *et al.*, 2021). As a result, domestic companies have become increasingly active in innovation, especially in emerging and deregulated industrial sectors outside the reach of state-owned companies, such as information and telecommunications equipment, smartphones, solar voltaic manufacturing, new energy vehicles, and drones, among others (Salike *et al.*, 2022).

From a scientific point of view, the emergence of innovation capability in Chinese industry began to attract the attention of scholars. Therefore, the first article on innovation capability by Guan and Ma (2003) emerged. This article proposes a methodology to endogenously evaluate the export performance of firms through a set of capabilities in the context of Chinese industry. It should be noted that this pioneering work was the turning point for the growth of scientific evidence on innovation capability, studying firms (Guan *et al.*, 2006; Liu *et al.*, 2018), and the influence of third parties (Zhao *et al.*, 2015).

These three stages were important for the Chinese industry to unleash its innovative activity. Figure 5 shows the three stages in the development of innovation capability in the Chinese industry, whose origins can be found in institutional, economic, and scientific changes.

The institutional lessons indicate that the consolidation of the innovation capability in the Chinese industry depends on three main stages. The first stage developed the change in the Chinese economic base, technology transfer from abroad to local industry was promoted, and incentives were designed to encourage the creation of private firms. Then, in the second stage, strategic industries of a technological nature were strengthened, as well as cooperation between firms and public research centers, and the use of external technology to imitate them was consolidated. In the last stage, the policy of “going outside” arose, consolidating foreign investment policies, strengthening government support policies, such as tax reductions, subsidies, scientific and technological development, among others. This implies an accelerated flow of scientific and technical knowledge and the obtaining of technologies for a later adaptation or improvement of scientific and technological development, making China one of the main countries of innovation in the world. For all of the above, the role of the central government encompassed international, economic, and institutional policy measures for the development and expansion of innovation capability. Only in this way did China manage to produce and export high-tech goods, changing the “made in China model” to “created and designed in China”.

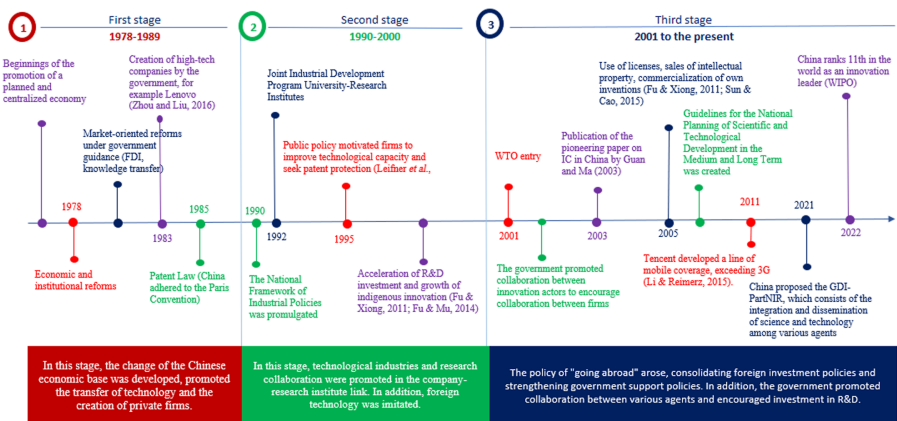


Figure 5. Stages of innovation capability in China. **Source(s):** Prepared by authors

4.2 Innovation capability in Chinese industry: firm-level lessons

The innovation capability is the meta-capability that contains a set of capabilities; that is, it is a big capability made up of other capabilities. In this study, we define innovation capability as a special repertoire of abilities (technological and non-technological) to provide new value solutions validated in the market to improve firm performance. In this systematic review, we identify that innovation capability in the Chinese industry is made up of five dimensions, or capabilities (see Table 5), which are the technological, operational, learning, marketing, and managerial capabilities.

Technological capability refers to the ability of a firm to acquire, incorporate, and use technologies to develop new products (Xu *et al.*, 2008), in terms of both goods and services. It is mainly related to the monitoring of advanced technologies, the adequate technological

Table 5. Dimensions of innovation capability

Dimensions	Variables	Authors
Technological capability	Monitoring of advanced technologies Technological allocation of labor resources Technological structure	Zheng <i>et al.</i> (2016), Wu <i>et al.</i> (2017), Zhang <i>et al.</i> (2018), Tang <i>et al.</i> (2023)
Operational capability	Use of physical resources Internal production coordination Worker specialization	Zheng <i>et al.</i> (2016), Shou <i>et al.</i> (2017), Chen <i>et al.</i> (2019), Yang <i>et al.</i> (2019), Wang <i>et al.</i> (2023), Wu <i>et al.</i> (2023)
Learning capability	Search for knowledge Knowledge sharing Orientation to learning	Wu <i>et al.</i> (2017), Yang <i>et al.</i> (2019), Zhang and Merchant (2020), Xie and Zheng (2020)
Marketing capability	Entrepreneurial orientation Marketing strategies Personalization of products and services	Yam <i>et al.</i> (2004), Yam <i>et al.</i> (2011), Zheng <i>et al.</i> (2016), Xie and Zheng (2020)
Managerial capability	Human resources management Leadership Organizational structure	Liu <i>et al.</i> (2018), Chang <i>et al.</i> (2019), Lei <i>et al.</i> (2019), Wu <i>et al.</i> (2023)

Source(s): Prepared by authors

allocation of labor resources, and the adequacy of a technological structure. The *monitoring of advanced technologies* ensures the necessary acquisition to incorporate new technologies and carry out activities that aid the systematic development of innovation activities. The *technological allocation of labor resources* favors the collaboration of internal and external knowledge for the development of new products and allows the acquisition of additional productivity benefits in R&D (Shang *et al.*, 2012). Finally, for Pan *et al.* (2021), the *adequacy of a technological structure* generates a meeting and stimulus effect towards researchers, R&D capital, and workers, providing a space for cooperation and communication between adjacent areas of the firm.

Operational capability is the ability to develop new techniques, methods, or procedures to produce goods and services in a flexible manner and with better quality (Shou *et al.*, 2017). This capability is summarized as the adequate planning of physical resources, the coordination of internal production, and the specialization of workers towards production. Adequate *planning of physical resources* will allow the correct use of internal and external resources to develop the production process (Liu *et al.*, 2018). The former increases a firm's ability to improve existing products and processes, while external resources broaden the firm's strategic access to new knowledge and new applications of its existing knowledge. *Cross-functional coordination* facilitates communication and joint actions between the different functional units of the firm (Yang *et al.*, 2019), which is essential for the successful implementation of strategic initiatives that improve the production process. In addition, *training workers through specialization* leads to better productivity, which in turn facilitates communication and interactions that streamline decision-making processes (Gu *et al.*, 2022).

Learning capability is the ability to identify, assimilate, and exploit new knowledge (Guan and Ma, 2003) to develop innovation skills (Zhang and Merchant, 2020). This can be summarized as the search for an exchange of knowledge, and an orientation towards learning. The timely *search for knowledge* generates solutions that, when the firm finds the appropriate information, add value and improve innovative performance. This allows more resources to be obtained and external knowledge to be exploited (Wu *et al.*, 2017). According to Yao *et al.* (2020), the *exchange of knowledge* improves the incorporation of knowledge processes as natural and integrated elements of the firm's processes, which increases the firm's knowledge and, in turn, improves its production. According to Xie and Zheng (2020), an adequate orientation towards *organizational learning*, referring to the cultural aspect that emphasizes the process of improving perceptions, knowledge, and understanding, will generate critical knowledge for product innovation and management practices to enhance the firm's performance (Yang *et al.*, 2019).

Marketing capability is the ability of a firm to advertise and sell products based on an understanding of consumer needs, the competitive environment, costs, and benefits, and acceptance of innovation (Yam *et al.*, 2011). Marketing capability ensures that the firm's path is improved through entrepreneurial orientation, the use of marketing strategies, and product customization. *Entrepreneurial orientation* emphasizes a proactive and aggressive approach to innovation that meets customer needs in order to stay ahead of the competition (Yu *et al.*, 2013). Entrepreneurial orientation is beneficial to acquiring and managing the knowledge of competitors, customers, partners, and internal employees (Yu *et al.*, 2013). On the other hand, the use of *marketing strategies* in a firm requires intangible resources that reveal the needs of consumers and build profitable relationships (Xie and Zheng, 2020). According to Zheng *et al.* (2016), the *personalization of products and services* is an important strategy to achieve the necessary flexibility, agility, and efficiency in a competitive market.

Managerial capability refers to the ability of a firm to guarantee its mechanisms and harmony, cultivating the firm's culture, and adopting good management practices (Yam *et al.*, 2004). Management capability is important for the promotion of encouragement, help, and the necessary resources (Lei *et al.*, 2019) to boost performance. Human resources, leadership, and organizational structure are basic elements of managerial capability. *Human resources* refer to the action of providing employees with social climates that motivate them to develop trust,

cooperation, and shared codes and language within a firm (Chang *et al.*, 2019). For its part, *leadership* is understood as encouragement and help from management for employees to share their knowledge (Yao *et al.*, 2020). This practice is beneficial to establishing emotional bonds with employees, inspiring them to higher values, and building a culture of collaboration and sharing (Lei *et al.*, 2019). For Hao *et al.* (2012), firms must structure responsibility and power. Only in this way, with an adequate *organizational structure*, will it be possible to guarantee the effective exchange of knowledge that a flexible firm requires in order to meet its objectives, such as improving its innovation capability (Yao *et al.*, 2020).

As we have seen, innovation capability is a meta-capability that comprises a set of dimensions whose purpose is for firms to develop innovation. In other words, technological, operational, learning, marketing, and managerial capabilities are complementary, and a combination of them creates a technological engine aligned with the firm's business engine. Thus, the firm manages to produce efficiently in terms of its way of bringing an innovative product to the market.

4.2.1 Performance. Performance refers to the result of innovation capability that is related to the increase and improvement of the firm's financial indicators. Undoubtedly, obtaining and improving performance is the desire of every firm when it decides to strengthen its innovation capability. That is why firms seek to ascertain what the consequences of innovation capability are when it comes to improvements in their economic indicators; that is, they look to identify how to improve the financial goals that accrue from innovation capability (Huhtala *et al.*, 2014). Performance helps growth and wealth creation, and is often related to financial indicators. Therefore, it is usually measured with objective variables. Performance may include sales volume growth (Zheng *et al.*, 2016), product competitiveness improvements (Ilmudeen *et al.*, 2021), market share growth (Grawe *et al.*, 2009), increased return on investment, assets (Shou *et al.*, 2017), and exports (Yuan *et al.*, 2016).

4.3 Integrating lessons learned: innovation capability framework in China

This paper develops an integrative framework on innovation capability in the context of China (See Figure 6) by drawing together the set of useful capabilities for managers and policymakers to make better decisions. The framework lays the foundation for building innovation capability in the Chinese industry through macro and micro level analysis. The macro level is linked to the institutional lessons carried out by the government, where it establishes a set of measures to create a propitious environment to unleash innovative activities in the industries. These Chinese lessons are made up of three stages (Figure 5), where each stage is cumulative, that is, each one depends on reaching the achievement of the previous stage. This allows the firm to make better decisions based on its environment with a view to facilitating its innovation process and strengthening its innovation capability.

At the micro level, we find the lessons at the firm level, which depend on 5 important capabilities. This constitutes the backbone of innovation capability in China, which, again, is the set of routines, knowledge, skills, and experiences encapsulated in the dimensions of innovation capability: among them, technological, operational, marketing, learning, and managerial capabilities (Table 5). Each of them has an essential function within the firm, involving different technicians who add value to the production. Unlike the macro level, here the use of capabilities is complementary, and the firm can carry out one or a set of them to improve its technical and development processes, that is, they are not exclusive. Finally, the framework concludes by explaining the results of the above, which ought to be the improvement in the firm's financial indicators (known as performance).

The suggested framework unifies the existing literature and highlights the main macro- and micro-level elements for building innovation capability in the Chinese industry. This framework is intended to fuel conversations about the factors that influence innovation capability and how it can be useful to improve performance. In addition, managers, academics, and policymakers can take advantage of the elements that make up innovation capability,

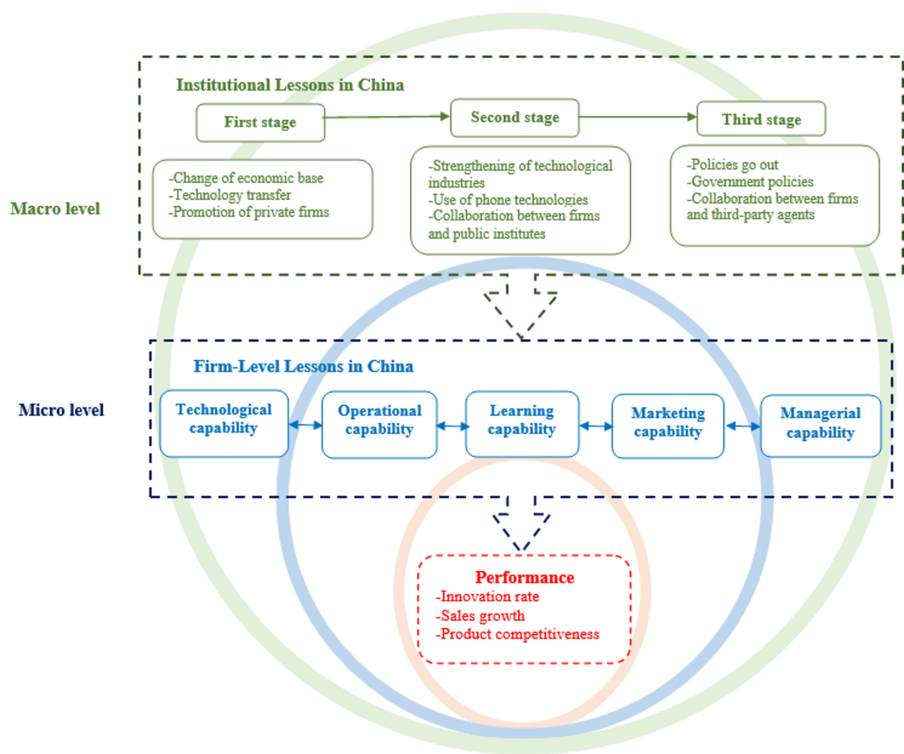


Figure 6. Framework on innovation capability in China. **Source(s):** Prepared by authors

adding them to their knowledge and factoring them into their decision-making. Therefore, the objective is to provide the lessons at the institutional and firm level that helped shape innovation capability, with a description of the elements that make it up and that influence them so that China can become one of the leading countries in the development of science, technology, and innovation.

5. Final considerations

The article aims to broaden the understanding of innovation capability in the context of the Chinese industry. After conducting an SLR on innovation capability in China, we made three contributions: (1) we described the stages in the institutional lessons to improve of innovation capability in China; (2) we identified five capabilities on China's innovation capability that serve as lessons to improve the performance of the firms; and (3) we proposed a framework whose purpose is to understand the complexity of the process that generates innovation capability in China. In this way, the foundations are laid to stimulate future research that guides emerging countries to generate innovation capability in their firms. Finally, we analyze how the strategies of Chinese manufacturing industries have adapted through their innovation capability and how these are aligned and compatible with our theoretical framework.

5.1 Theoretical implications

The study proposed a systematic review of the literature in the Chinese context. In so doing, we attempt to cover the existing gap in the literature on the state of the art of innovation capability,

which focuses mainly on studies from developed countries. Consequently, this article is pioneering in its systematic review of the literature of an emerging country, and it can serve as a guide for other reviews in other contexts. Likewise, we proposed a theoretical framework to identify the dimensions that led to China becoming one of the main countries concerning innovation. This framework can be an input for the development of other studies, whether theoretical or empirical. Ultimately, empirically testing the framework proposed in this article will expand the frontier of knowledge about innovation capability.

5.2 Managerial implications

This article noted that innovation capability can be divided into technological capabilities (technological and operational capabilities) and non-technological capabilities (managerial, marketing and learning capabilities). The former are essential to create or improve new products and processes and thus produce on a commercial scale, while the latter are the cumulative capabilities that improve the firm's organization and help it generate a better value proposition for the market.

Therefore, senior management must strengthen the innovation capability of their firms. This means implementing direct and effective strategies to strengthen technological and non-technological capabilities. With respect to the former, it is necessary to continue investing in research and development to promote creative and systematic work, in addition to training the personnel assigned to R&D activities. In the case of the latter, managers must strengthen their firms' reputation and communicate the product and service quality achieved through production aligned with customers' needs (Pun, 2005; Adebajo *et al.*, 2018). Managers should also encourage organizational learning by emphasizing the learning capability of the organization and viewing learning as an investment rather than an expense (Wang and Chen, 2013). This will promote an internal culture of information sharing and knowledge dissemination that gives rise to a climate of trust (Lei *et al.*, 2019). In summary, the investment in R&D, the motivation and training of the personnel and the improvement of the product to satisfy the needs of the clients, as well as the communication within the firm indicate that strengthening the firm is necessary to contemplate a holistic vision of the development of strategies on their innovation capabilities that translate into better performance. It should be noted that these capabilities are complementary and do not require multiple strategies to be carried out at first.

5.3 Implications for public policy

When it comes to the public policy implications of our research, governments should play a positive role in guiding and helping domestic firms to accumulate innovation capability (Fan, 2006). This entails developing a set of measures to strengthen, promote, and develop their innovation capability by taking into account the different regional institutional environments (Zhao *et al.*, 2015). First of all, the government should allocate subsidies and increase financing for activities that improve technological and operational capability. This means allocating resources to patent-intensive industries, thus promoting the production and transformation of high-quality patents and building an optimal information platform for patent operation. On the other hand, about non-technological skills, the state should encourage investment in education, upgrading of educational and training institutions, and staff training to improve the overall quality of scientific and technical staff (Zhang and Zheng, 2011; Yang *et al.*, 2012) and the dissemination of knowledge. Raising the level of human capital is an important effort that will promote the exchange of knowledge and adequate use of resources. Lastly, we saw that government policy is important to open borders and access current technologies and knowledge in a faster and more efficient way, however, this must be marked by avoiding a technological dependency that delays the objective of increasing local innovation.

5.4 Study limitations

Finally, this research is not without limitations. First, the review focused on 142 documents, including articles and books published in indexed journals on innovation capability. However, this does not mean that we cover the entire universe of studies on this topic. Second, only Scopus and WoS were used. Future studies might incorporate other databases to ensure a greater number of studies and make the sample more representative. Third, and last, content analysis techniques can be criticized for possible subjectivity; however, when we talk about the interpretive synthesis of previous literature it may be impossible to avoid a certain level of subjectivity.

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