ISSN 2522-6398 Vol. 2, Issue 12: 74-91, DOI: 10.25236/FER.2019.021213

Innovation in China: a Systematic Literature Review

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ABSTRACT. *The purpose of this paper is to assess China's national system of innovation by analyzing it as a whole. To assess innovation in China, a systematic literature review was conducted. It was found that the Chinese innovation system is unique in its mixed top-down approach, and deserves to be viewed from a Chinese view. China's innovation system is also heavily divided by regions, as some have high innovation levels and others remain low. It is also found that there is little research on academia and individuals and innovation, and collaboration is becoming a popular organizational research area within innovation research. Practical implications - this paper shows that a top-down innovation approach can be successful. Secondly, policy makers should attempt to create stronger bonds between universities and the industry and government. Thirdly, policy makers should consider the importance of the individual in the process of innovation. Originality/value – This is the first literature review on innovation in China at this range. This literature review assesses the current snapshot of China's innovation system and offers readers the opportunity to not only get an understanding for China's innovation system but also identify research gaps.*

KEYWORDS: *Innovation; China; Systems of innovation; Organizational innovation; Government innovation*

1. Introduction

Innovation is the creation of something new or the change of an existing phenomenon (Tidd et al, 2001). Innovation has long been considered an important part of an economy, as Schumpeter described innovation as the revolution of economic structure and creating economic growth to be at the heart of capitalism (Schumpeter, 1932). Since then the importance of innovation for economic growth has not only been theoretically established but also empirically shown by various authors (Nadiri, 1993;

ISSN 2522-6398 Vol. 2, Issue 12: 74-91, DOI: 10.25236/FER.2019.021213

Wong et al, 2005). It is thereby clear that innovation is absolutely essential for a country to develop long-term sustainable economic growth.

In China, economic growth has been rampant since Deng Xiaoping's open market reforms, as China's economy has grown by nearly 10 percent on average per annum (World Bank, 2018). Since the global financial crisis of 2008, China has been the largest contributor to world growth and is the second largest world economy (World Bank, 2018). This extremely fast and rapid economic rise from primary sector Economy to an industrial superpower offers a viable case study for the emergence of innovation. Fan states that China's innovation capabilities have been evident in "R&D personnel, R&D expenditure, patents, high-tech and service export, and scientific and technical journal articles" (Fan, 2014).

Whilst innovation has occurred rapidly and significantly, due to China's relatively rapid economic rise, it is still a relatively novel phenomenon. The purpose of this research paper is to evaluate China's innovative capabilities by investigating its national innovation system and assessing the systems different components. A national innovation system (NSI) is framed as the innovative activities within the institutional national context (Edquist & Lundvall, 1993), where NSI are comprised of the government, firms, academia, and individuals all engaging in this system (Hall et al, 2014). This results in the general research question:

What is the current state of China's national innovation system?

However, in order to answer this question, it is at first important to investigate the condition of the various components of China's NIS. Hence, following fragmented research questions are to be considered:

1) How is the government acting within the innovation system?

2) How are organizations acting within the innovation system?

3) How is academia acting within the innovation system?

4) How Are Individuals Acting within the Innovation System?

Answering these research questions will help answer the general research question. A systematic literature is used where findings are organized into each fragmented research question.

2. Assessing Innovation Activity in China

In order to assess China's current innovation system and offer a holistic review of it, it is important to consider the different players within it. One can consider innovation from a systems perspective, in viewing it from a national and/or regional level, yet one can also examine the different players at work. The different players are the individual,

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firms, academia, and the government. This is supported by various research. Rothaermel & Hess found evidence of innovation on individual, firm and network level (Rothaermel & Hess, 2007). The triple helix and quadruple helix model of innovation are models solely created on the paradigm that different actors have different parts to play in innovation (Etzkowitz, 2003). The triple helix model discusses the roles of academia, industry and government in innovation (Leydesdorff & Etzkowitz, 1998). The quadruple helix model of innovation, adds a fourth component to this framework – the media-based and culture-based public (Carayannis & Campbell, 2009). This addition is in part due to the global societies shift to a more knowledge based society (Etzkowitz, 2003). Considering the observation by previous scholars that innovation ecosystems are composed of several players and factors it is deemed necessary to deconstruct and analyze China's innovation ecosystem both fragmented and as an entire system. Hence the analysis and findings are categorized as follows:

(1) Systems of Innovation

There are two key approaches to looking at systems of innovation. Firstly, as a National Innovation System (NIS). The NIS is the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies (Freeman, 1995). As such, under this view, one regards China as an entire system of innovation. Secondly, one can view a system as a Regional Innovation System (RIS). A RIS is descriptive way of capturing how technological development takes place within a territory (Doloreux & Parto, 2005), and when observing China from such a perspective, China is comprised of numerous RIS, instead of one NIS.

(2) Government and Innovation

The government is a key player within the national innovation system. A government can provide the opportunity for technological transformation and sustainable development through the establishment of innovation policies and regulation (Bossink, 2002). Depending on the rate of regulation the government has a different role in innovation. For example, in a laissez-faire economy, the government regulates the market only lightly, whilst the market forces dictate innovation more. In a tightly controlled economy on the other hand, the government has a pivotal role in innovation – by controlling and regulating, creating new and regulating existing markets (Leydesdorff & Etzkowitz, 2000).

(3) Firms and Innovation

From a firm perspective, innovation incorporates individual, firm, and network components. The human capital aspect of an individual should not be neglected when looking at innovation, playing an important role together with firm and network mechanisms (Rothaermel & Hess, 2007). Crossan & Apaydin managed to create a multi-dimensional framework for organizational innovation based on reviewing the plethora of fragmented organizational based innovation research out there. managing to connect

ISSN 2522-6398 Vol. 2, Issue 12: 74-91, DOI: 10.25236/FER.2019.021213

three determinants of organizational innovation – leadership, managerial levers, and business processes. They found that there was not a unifying theory of innovation that is capable of describing innovation across levels. Their framework can be used to understand innovation on an organizational level (Crossan & Apaydin, 2010).

(4) Academia and Innovation

With an increasing shift to knowledge-based societies and the increasingly important role universities play in society, the role of academia in innovation has become significant (Etzkowitz, 2003). University-led research can be commercialized by firms or entrepreneurs to increase innovation performance, and hence academia's role in innovation can be significant (Grimpe & Hussinger, 2013).

(5) Individuals and Innovation

The human capital aspect of an individual is an important factor in innovation as it often plays importance together with firm and network mechanisms (Rothaermel & Hess, 2007). The trend of open innovation (Chesbrough, 2006) and increased user involvement (Von Hippel, 2005), as well as the acknowledgment that individual cognition shape innovation (Wu et al, 2014) further point towards a need to examine the individual's role in the innovation process.

3. Methodology

To assess China's national innovation system, a systematic literature review (SLR) was conducted. A SLR is a comprehensive review of academic research in a certain subject area, using a methodological approach that is organized and can be replicable (Tranfield et al., 2003). As such, this systematic approach to reviewing academic literature has major advantages and is becoming more common within the social sciences field, as a systematic approach increases transparency and creates a standard for academic quality (Hallinger, 2013). To execute the SLR a five step approach was used.

First the research problem was defined: Assessing the China's current national innovation system, by examining the system as a whole, as well as dissecting it to assess the different components of China's national innovation system. As the second step, in order to guarantee high-quality academic work throughout all works, only SSCI journals were deemed suitable for this review. Articles were retrieved by searching "Innovation in China" and setting two filters. The first filter was as previously mentioned that all articles had to been published by SSCI journals and the second filter used was to only display results from the years 2011 to present. This resulted in a total of 68 articles that were deemed relevant.

Table 1 in order to analyze the data, the data was grouped into the five categories: Academia, government, individual, system, and organization. Admittedly, this approach

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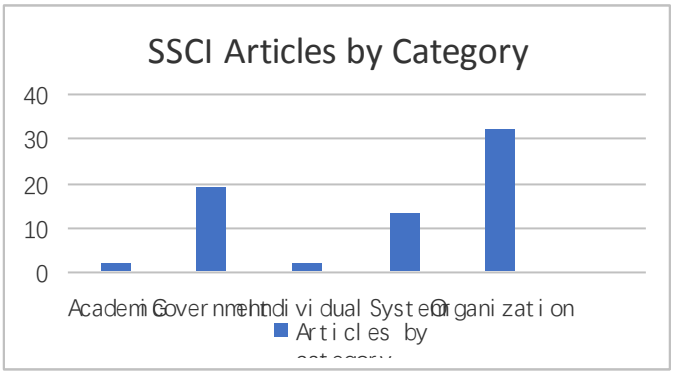
of categorization is to some degree subjective and one could argue that there is a lack of systematic approach here, yet as Tranfield et al point out, qualitative research is at its core subjective (Tranfield et al., 2013). Furthermore, it has to be considered that the nature of this research is exploratory restricting a more systematic approach. The 68 articles were grouped by their major scope(s) of research. 2 Articles focused on Academia and innovation, 19 on Government and innovation, 2 on Individual and innovation, 13 on Innovation as a system, and 32 on Organizations and innovation (*Table 1*).

Table 1 Ssci Articles by Category



4. Findings

4.1 RQ 1: China's Government and Innovation

China's current innovation approach appears to be top-down with both market forces and regulation at work. Government led innovation in China seems to be diverse, varying by type, size, distribution patterns, administrative hierarchies and sectors (Wu et al, 2012). Public sector innovation in China is regarded as a well-established practice, and China has developed its unique public innovation model that has its own unique 'Chinese characteristics' (Wu et al, 2012).

Whilst China has moved towards economic decentralization, the central government has still made use of heavy regulation on foreign high-tech companies to protect their own industries and facilitate knowledge transfer (Tyfield et al, 2015). Tyfield et al recognize that this mixed system has unique characteristics and challenges. Many innovation projects are top-down government controlled and there are numerous state-owned enterprises that are encouraged to innovate. Hence, one can observe that China's

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innovation system as of now exhibits both capitalist and regulated characteristics (Tyfield et al, 2015). Klochokhin even goes as far as stating that China's example can even be seen as a best practice case study when one investigates how to transition from a state planned to a market economy, arguing that China has experienced significant success with their innovation strategies (Klochikhin, 2013). State ownership also seems to have benefits in innovation when it comes to emerging economies (Zhou et al, 2016). Yet this seemingly also makes firms less efficient in the way they use these financial resources to create innovation. Furthermore, it is found that a state's major financial involvement in innovation is of detriment to innovation. They conclude that a minority state-ownership of firms is favorable for innovation (Zhou et al, 2016).

China's top-down R&D approach has been effective in creating agglomeration forces and developing innovation. China has built their own unique innovation system via a top-down approach, creating innovative regions such as Guangdong, Shanghai and Beijing. In order to diffuse this innovation from the big centers into other cities developing a less centralized strategy may be important (Crescenzi et al, 2012). This approach has been effective in fostering innovation and seemingly prioritizing the sectors innovation occurs in. Jing & Gong found that the combination of government engineering and civic engagement can have an impact on innovation activity. They found that Shanghai's government led top-down approach to social innovation showed levels of success in creating social innovation, yet caused several problems such as inter-agency coordination and the lack of managerial experience and capacity among the government in this field of area are key areas of concern (Jing & Gong, 2012).

One strategy the Chinese government already adopts to increase innovation is public procurement. This has been used by the government as an innovation policy instrument, specifically to promote indigenous innovation. Whilst both public procurement instruments accreditation and signaling did not work according to plan, they did have a positive effect on indigenous innovation capability in China (Li & Geroghiou, 2015). Another strategy implemented has been to force technology transfer from foreign companies, especially from foreign R&D centers based in China. This is done by implementing stringent rules on patents and regulating procurement. Whilst this results in China being less attractive for R&D activity, the authors state that the government believes that the Chinese market is too valuable for multinational firms to neglect, and that multinationals are willing to engage in this technology transfer trade-off in order to stay in China (Grimes & Du, 2013).

This shows that China's current approach is top-down heavy, which is not necessarily a bad thing. Evidence above shows that this approach has caused a lot of positives, yet there are also clear drawbacks occurring. There is a clear need to optimize this top-down approach.

(1) Optimizing the Government's innovation approach

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In order to optimize innovation policy, institution-based barriers are to be considered, which are present in China's innovation environment (Zhu et al, 2011). The five key institution-based barriers seem to be competition fairness, access to financing, laws and regulation, tax burden, and support systems. There seems to be a clear need for policies to reduce barriers and create a more welcoming environment for entrepreneurship and innovation (Zhu et al, 2011). One tool to reduce institutional barriers that can be used is the policy entrepreneur (Zhu, 2012). In a paper specialized on housing reforms in Guizhou it was found that the policy entrepreneur made use of a wide variety of strategies to improve the institutional environment for innovation. By acting as a broker between government and industry the policy entrepreneur was able to create networks and break down barriers. It was found that the successful brokerage and actions of this policy entrepreneur not only helped to break down the barrier between civic engagement and institution, but much more decrease the institutional barriers to innovation as a whole (Zhu, 2012).

As such Fu & Mu argue that as the Chinese government is determined to building an innovation-driven economy, it should continue to increase R&D investment and education investment. Also, the authors argue that firms need to be incentivized heavily for creating innovation. Furthermore, as the major policy intervention measure they argue that the Chinese government should focus on creating new human resource and funding management practices, by changing appraisal and reward systems and changing the management of research funding (Fu & Mu, 2014). Several points can be considered when considering the type of government intervention. Firstly, the stage of the innovation. Gao states that during technology development and diffusion stages the government needs to take a mixed regulative approach, whereas in indigenous innovation more stringent government intervention is appropriate (Gao, 2015). Secondly, Zhou et al state that state ownership can increase innovation in emerging economies, and thus is a suitable model to consider. However, there are clear drawbacks from state ownership such as a decrease in efficiency in the use of financial resources. A minority state-ownership seems to be the optimum solution here (Zhou et al, 2016). Thirdly, the top-down innovation approach has created innovative regions such as Guangdong, Shanghai and Beijing, yet has failed to diffuse. A strategy focused on diffusing this innovation is important to create further innovation and a less centralized strategy may be necessary to do so (Crescenzi et al, 2012). These findings show several key areas where the Chinese governments approach to innovation can be optimized. Decreasing institutional barriers, setting the right incentives, and optimizing policy tools such as the policy entrepreneur are all aspects that can be fine-tuned in order to optimize the governments innovativeness.

(2) The Government & Renewable energy industry

At present the public sector plays a pivotal role in promoting low carbon technology and the Chinese government seems to consider the industry's involvement in promoting

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low carbon technology as important and strives to encourage this (Shi & Lai, 2013). As McDowall et al discuss, government commitment has shown to increase investor confidence in the wind energy industry, causing an increase in investment and rapid market growth. This outlines a strong reason for why the government should back favorable future industries. McDowall also outline the power of protectionism that protected an infantile wind energy industry, and this is another policy measure that has proved successful (McDowall et al, 2013). The E-bike industry has also shown that government research institutes can help facilitate innovation by creating diffusion and causing knowledge spillovers. As Klagge et al mentioned drawbacks to government involvement have been the lack of coordination between energy and innovation policies, inadequate R&D spending, and a weak link between academia and the government. Jin also states that merely focusing on R&D may not fix issues and a more sophisticated policy mix is required. This shows that China's policy mix needs to be nuanced, acknowledging the potential limitations and weaknesses of certain policies. Zhu has discussed the policy entrepreneur who breaks down barriers between government and industry, and as such can be pivotal when it comes to discovering an optimal innovation policy mix (Zhu, 2012).

The Chinese government sees it as a strong priority to invest into renewable energy in order to accommodate for China's enormous energy needs and grow the renewable energy industry.

One industry where the governments high priority approach to renewable energy has been evident is the wind energy industry. The central governments high commitment to creating innovation in the field of wind energy has generated significant investor confidence which in turn has created rapid market growth. Furthermore, the government has used protectionist policies in this industry to develop the domestic wind power industry (McDowall et al, 2013). In the case of the electric bike industry the government's role has also been pivotal in fostering innovation. Especially in the early stages of the development of the e-bike industry, the Chinese government has had a large role to play. The early motors were developed in a government research institute in Shanghai. As the industry became more developed, the Chinese government switched from more of a mission orientated innovation strategy to a diffusion orientated strategy, facilitating knowledge spillovers among industry players and supporting the firms in this industry to innovate (Ruan et al, 2014). Ruan et al found that this type of mix of government policy to create the electronic bike industry is unique in creating disruptive innovation (Ruan et al, 2014). This heavy R&D mostly occurs in the form of national science and technology programs coming mainly from The National Basic Research Program, the National High-tech R&D Program, and the National Key Technology R&D Program. The authors find that whilst the quantity of investment is growing, there seems to be a lack of focus on demonstration and diffusion of the funded technology programs. Furthermore, do they find that there seems to be a lack of opportunities and incentive systems for the private sector to participate in carrying out this innovation. It is

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found that the majority of technology innovation programs are carried out in cooperation with Universities and/or research institutes without the involvement of industry partners (Huang et al, 2011).

Klagge et al find several key issues within the scope of innovation and the government in the energy industry in China. Firstly, there seems to be a lack of coordination between energy and innovation policies. Secondly, they deem the structure and quantity of R&D spending too low for the objectives they are meant to reach, and also find that there seems to be a clear lack of collaboration between academia and the government. They state that the highest policy priority in the wind industry should be to integrate innovation policies into the wind industry policy effectively (Klagge et al, 2012). Similarly, Jin states that while China's R&D efforts will play a pivotal role in curbing carbon emissions, the mere use of R&D will not help China reduce its carbon footprint effectively. It is found that there is a clear trade-off between economic optimization and carbon emissions, and that technological innovation alone cannot fix the climate issue (Jin, 2012). Overall a study by Ru et al outlines the Chinese governments approach within these industries, by outlining the transformation of technological capacity within the wind turbine industry. They showed that the industry's innovation mode has undergone four stages of transition, which were catalyzed by early-stage government led R&D investment, which transitioned into imitative innovation processed, then cooperative innovation, and finally indigenous innovation. Public policy has shown to be the driving force in this process, especially before 2008, whilst after 2008 the government has been able to take a smaller role in this process (Ru et al, 2012).

The sheer amount of academic research done on China's renewable energy sector shows how successful the government's approach has been. This furthermore rectifies China's public policy driven innovation approach. Using this approach has key advantages, one of them being the ability to drive favorable innovation. Renewable and sustainable industries are industries of the future, and being present in these is of key value. As such, the renewable energy sector is an excellent case study of China's successful innovation approach.

4.2 RQ 2: China's Firms and Innovation

The organizational innovation research in China has been rich and varied in topics. Wang & Lin state that firm-level attributes are essential for a firm to improve its innovation performance (Wang & Lin, 2012), which is reflected by the heavy research focus on firm-level attributes to innovation within this sample. The vast amounts of research show that Chinese firms are investing time and resources into optimizing organizational variables in order to be more innovative.

Table 2 shows the firm-level attributes discussed throughout the theory. As seen, diversity & conflict management, product management, type of ownership, brand image,

ISSN 2522-6398 Vol. 2, Issue 12: 74-91, DOI: 10.25236/FER.2019.021213

family involvement, integrated risk management, flexible organizational structures and processes, innovation intent & infrastructure, green management and firm-level networking all shape innovation within an organization. Summarizing these findings one can say that in general creating flexible organizational structures and processes increase innovation capabilities (Williamson, 2016), and strategies to increase flexibility and the creation of new will aid in increasing the innovation levels of an organization. Shown examples here are the focus on new product sales (Sharif & Huang, 2012) and green management (Guoyou et al, 2013).

Table 2 Firm-Level Attributes

Table 2 - Firm-level attributes
Diversity & Conflict Management (Chen et al, 2012) (Qian et al, 2012)
Product Management (Sharif & Huang, 2012)
Type of Ownership (Jiang et al, 2013)
Brand image (Zhang et al, 2012)
Family involvement (Liang et al, 2012)
Integrated risk management (Wu & Wu, 2013)
Flexible organizational structures and processes (Williamson, 2016)
Innovation intent & infrastructure (Yang, 2012)
Green management (Shu et al, 2016)
Firm-level networking ability (Shan & Jolly, 2013)
Knowledge acquisition/learning abilities (Zhou & Li, 2012), (An et al, 2016), (Wang et al, 2012), (Bao et al, 2012), (Wong, 2012), (Wang et al, 2013), (Lin & Su, 2014), (Xu et al, 2012), (Fu et al, 2013), (Wang et al, 2012), (Li-Ying & Wang, 2014), (Sun & Lee, 2013)

(1) Knowledge acquisition

The biggest focus within organizational research in innovation in China has been knowledge acquisition. The prominence of this stream of research only seems plausible as knowledge acquisition is essential when it comes to innovation performance. These findings confirm the knowledge-based view theory, as knowledge is value, and an increase in value has positive effects on a firm. Several types of knowledge acquisition were found. In general, firms with broad knowledge should focus on internal knowledge sharing in order to achieve radical innovation, whereas firms with a deep knowledge base should focus on market knowledge acquisition in order to achieve radical innovation (Zhou & Li, 2012). Over the past ten years there has been a heavy focus on the knowledge based view within Business Management literature and as such is of no surprise of the focus on knowledge acquisition. A key trend to acknowledge here is the importance of collaboration.

Chinese firms are increasingly harnessing collaboration in order to improve their innovation capabilities. Collaboration strategies both include inside firm collaboration

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and external collaboration between the firm and its external environment. As Wong states, knowledge sharing has a great effect on green process innovation. The importance of collaborative innovation within organizations is increasingly being recognized by organizations (An et al, 2016). An et al study collaborative innovation in China and find that collaborative innovation community capacity building (CICCB) can increase innovative performance by organizations and is increasingly being demanded in China (An et al, 2016). In a study focused on open innovation, scholars found that an open innovation approach increased overall innovation activity. The authors found that the firms within this samples used four identical steps. Firstly, they used technology in-licensing to obtain technologies. Secondly, they created long-term alliances with foreign partners. Thirdly, they collaborated with universities and R&D institutes. Lastly, they also collaborated with local industrial communities (Wang et al, 2012). Wong found that knowledge sharing is a mediator between green requirements and green product success and between green requirements and green product and process innovations. Furthermore, the author found that knowledge sharing has the strongest impact on green process innovation (Wong, 2012).

The research interest in collaboration shows the trend of companies acknowledging that innovation does not only stem from protecting knowledge, but also from sharing it. This development in both theory and practice has the potential to disrupt traditional innovation practices as firms may become increasingly willing to share valuable information. The evidence of collaboration practices within Chinese organizations suggests that Chinese organizations are at a sophisticated stage of innovation practice, as collaboration is a relatively new trend.

(2) Learning

Technical learning, administrative learning, organizational unlearning, and organizational flexibility all show to have positive effects on firm's innovation performance (Bao et al, 2012), (Wang et al, 2013). Also, Chinese firms should focus on improving trust, information sharing and joint problem solving within their networks to increase technological innovation (Xu et al, 2012). Furthermore, Fu et al find that firms engaging in the highest intensity of interactive learning with the widest scope of business partners seem to achieve better innovation outcomes. Also, the authors find a link between intensive interactive learning levels and the use of informal guanxi networks as a complement to institutional deficiencies (Fu et al, 2013). Chinese firms have been engaging in learning, adopting and implementing management innovation practices that have a track record of being successfully implemented. This causes the adoption of these practices to be of comparatively low risk as they are well established (Lin & Su, 2014).

Again, these findings do not challenge the current theoretical development, much more do they confirm it. They also show that Chinese firms are at a substantially

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developed stage at which they deem to optimize their organizational structures and processes in order to increase innovation.

(3) Learning by licensing & joint ventures

"Learning-by-licensing" can increase innovation performance (Wang et al, 2012). Also, technology in-licensing has shown to have contributed more to creating indigenous innovation compared to domestic licensing for Chinese firms. This is in opposition to the national strategic innovation policy, as it states for Chinese firms to reduce their dependence on foreign technology (Li-Ying & Wang, 2014). Therefore, there is a need to evaluate how decreasing the Chinese firms' dependence on foreign technology would affect Chinese firms' innovation performance, and whether the positives outweigh the negatives here.

Sun & Lee find that whilst emerging economies tend to lack innovation, international joint venture (IJV) portfolios are effective in helping increase it. They find that an emerging economies firm innovation ability increases when there is an increase in structural hole positions in its IJV portfolio, yet decreases when network centrality (Sun & Lee, 2013). Here it shows that the degree of development of an economy plays a strong part, and as such it is to be evaluated at what stage of China's development joint ventures stop having the positive effects they sought to have.

(4) External factors

The relationship between firm innovation and performance seem to be highly influenced by the institutional conditions of the country where the firm is located (Bong Choi & Williams, 2013). Favorable institutional conditions can aid certain types of firms in their access to finances, banking services, and government support (Ma et al, 2014). There is also evidence that China's external factors have facilitated product innovation for a foreign firm, who was then able to use this product innovation in their home market (Corsi et al, 2015).

Several external factors impacting organizations innovation abilities are important to note. Firstly, regional factors seem to depend on the type of innovation, the firm's strategy, motivation, and other factors (Wang & Lin, 2012). Governments should thus consider how their type of policy mix affects the types of organizations they are trying to assist. Secondly, supplier involvement is to be considered. Jean et al find evidence that early co-design can increase innovativeness, yet state that knowledge protection and/or trust are to be considered here. They also find that knowledge protection, trust, and technological uncertainty all increase product innovation (Jean et al, 2013). These findings show that whilst collaboration is on the rise, the external environment needs to be considered. It may be detrimental to a firm to engage in collaboration practices in certain environments. Thirdly, both formal institutional factors such as government support and informal institutional factors such as social legitimacy can benefit a firms' innovation performance (Shu et al, 2016).

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(5) Individuals in organizations

Two articles within the organizational sample focused on individuals within organizations, managers to be more precise. As Damanpour & Aravind point out, focusing on the individual within organizations is not a common innovation topic. They state that there is a need to investigate managerial innovation, and Tang et al confirm this by showing that executive hubris causes higher firm innovation (Damanpour & Aravind, 2011). Tang et al investigate executive hubris in regards to firm innovation. Executive hubris is hyper core self-evaluation (Hiller & Hambrick, 2005), and Tang et al find that executive hubris causes higher firm innovation.

These findings show that firstly the individual sphere is greatly under-researched, and secondly that individual traits can have a significant impact on the innovation performance of an entire firm.

4.3 RQ 3: China's Academia and Innovation

Overall, there seems to be a weak link between academia and the national innovation system in China. Two articles within this sample focused on Academia and innovation. Whilst other articles did discuss academia partially, they did not focus on it its role in the innovation process. This lack of theoretical research aligns with the weak practical link between universities and enterprises that Cai & Liu find (Cai & Liu, 2014). They point toward inadequate protection of intellectual property as well as low levels of trust between Universities and firms as a key problem within the relationship. Furthermore, Kristensen & Nielsen discuss clear gaps in Chinese IR research that Chinese scholars are struggling to close due to limited attention regarding the topic. This illustrates that a lack of attention is being given to Chinese academia, that may in turn have detrimental effects on the innovation system (Kristensen & Nielsen, 2013).

Whilst the theory clearly states that a strong link between academia and innovation exists, the research here shows the clear under-representation of research on this topic. It seems that not only is there a limit of theoretical work on the subject, but also is there a clear barrier in practice. The neglect of both the theoretical and practical sphere are potentially hindering the Chinese innovation system to perform at its optimal level.

4.4 RQ 4: China's Individuals and Innovation

Merely two studies focus on the effect of individuals on innovation. Lindtner discusses hackerspaces, which are a new phenomenon. Hence, the lack of academic research on the contribution of hackerspaces is unsurprising. Lindtner states that hackerspaces can be major catalysts for technological innovation and as such can increase innovation (Lindtner, 2014).

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The second study discusses farmer innovation diffusion and shows the importance of leadership in causing farmer innovation (Wu & Zhang, 2013). This finding shows that even when observing a non-technologically complex product the topic of innovation from an individual's perspective can show valuable insight. Similar to the research of the individual sphere within organizations and innovation, the individuals' role as a whole is under-researched. The rapid growth of hackerspaces shows that in practice, the demand is there, and as such there is a need for theoretical development.

4.5 RQ 5: China's system of innovation

The findings show that China's national innovation system has produced significant innovation activity. It is clearly visible that China's NIS is heavily influenced by the Chinese government that uses a top-down strategy and central Science & Technology plans, whilst working together with research institutes, such as the Chinese Academy of Sciences. This institute occupies a major role in the national research system, and as such has an important role to play for China to continue becoming an innovative nation (Augier et al, 2016). These findings show that the Chinese government realizes the importance of its academic institutions as a part of the entire innovation system. Reviewing academia's link does show that there may be a clear need to strengthen the ties between academia and the innovation system further. It is clear that China's national innovation system has its own unique strengths and weaknesses. The organizational, psycho-cultural and institutional factors of China need to be considered in order to fully understand China's long-term innovation strategy. Augier et al argue that China's top-down innovation system may be inhibiting innovation (Augier et al, 2016). However, when reviewing the government's nuanced approach, it seems that the top-down system has had significant success, and it is more about fine-tuning this top-down approach, rather than abandoning it.

Furthermore, Fan states that China's post reform change has caused China's national innovation system to change and enable creativity and innovation. China has formed global linkages, and Chinese returnees seem to be having a significant effect on Chinese innovation levels and sees this as a need for further evaluation (Fan, 2014). This is further evidence for the sophistication of China's innovation system as a whole. This is confirmed by findings that China is currently developing its own indigenous innovation capabilities, and a more Chinese-centric view of innovation in China is necessary (Vinig & Bossink, 2015).

It is therefore visible that China's national system of innovation is sophisticated and developed. There are certain aspects of its top-down approach that can be optimized. Also, another issue with China's national innovation system is the regional inequality and spatial distribution of innovation (Wang et al, 2016). Over 70 percent of all patents are registered in coastal regions, and provincial spillovers from R&D investment are

ISSN 2522-6398 Vol. 2, Issue 12: 74-91, DOI: 10.25236/FER.2019.021213

significant, causing spatial externalities where some regions develop to the expense of others (Wang et al, 2016). Hence, this is a structural weakness of China's national innovation system, and in order to improve it strategies should be implemented that decrease the regional disparity.

(1) Regional innovation systems

Chen & Guan show that most of China's regions perform inefficiently when it comes to innovation performance. They find that one-fifth of all regions performed efficiently in the entire innovation system. Whilst significant regional investment has helped socio-economic progress, it has not helped regional innovation performance (Chen & Guan, 2012). This shows the regional unbalance, and shows that the majority of Chinese regions is not performing efficiently within the innovation process.

An explanation for this regional disparity is offered by Crescenzi and Rodriguez-Pose. They find that the geography of innovation in China is driven by agglomeration forces, stating that wealthier regions with good infrastructure and a richer industry absorb innovative potential from neighboring areas (Crescenzi & Rodriguez-Pose, 2012). Hence, in order to stop this from happening further, policy may need to be implemented that inhibits the absorption of innovative potential from neighboring areas. Further policy that might alleviate this is discussed by Lau & Lo. They find that regional innovation initiatives, knowledge-intensive business services and value chain information sources all impact innovation performance within a RIS by improving firms' absorptive capacities, which results in increased innovation performance (Lau & Lo, 2015).

Yang et al state that in order for regional innovative capability to improve throughout China, China should focus on improving human capital in the way of absorbing and learning knowledge that is embodied in imported technology (Yang et al, 2012). This shows additional policy measures that can be used in order to improve these regional imbalances. Education programs to improve human capital in these regions could increase the innovative capabilities of such regions. Also, the authors also state that targeted FDI can help improve innovative capability. It is necessary to consider the suitable industries of this FDI in order to improve capabilities effectively (Yang et al, 2012).

One paper finds that outward foreign direct investments (OFDI) seem to have a large impact on domestic (Li et al, 2015). This is likely to occur due to that richer regions attract more inward FDI, and with these additional resources are able to develop further and quicker, which in turn bolsters innovation and outward foreign direct investments that can further increase innovation. It is therefore essential to improve a regions' inward FDI, in order to give the regions industry the opportunity to grow and eventually develop OFDI.

(2) Synergy effects via networks

ISSN 2522-6398 Vol. 2, Issue 12: 74-91, DOI: 10.25236/FER.2019.021213

Regional knowledge spillovers have had a significant impact on patent growth by causing synergy effects. These regional knowledge spillovers have contributed to regional productivity gains and as such have also driven innovation growth. Specifically, for design and utility patents these regional knowledge spillovers have had a large effect (Shang et al, 2012). Similarly, Industrial Symbiosis (IS) has been used to increase eco-efficiency. Using IS can result in reducing carbon dioxide emissions whilst also causing synergy effects (Dong et al, 2014).

6. Conclusion

This paper shows that China's innovation system has developed to a sophisticated level. China has created its own unique 'top-down' innovation approach in which there is evidence of indigenous home-gown innovation. Some critics argue that China's 'top-down' approach may be inhibiting growth, however there is not much evidence for this. The renewable energy industry is clear practical example for how a government-led innovation approach has built an innovative industry sector. The answer therefore seems to be not whether or not to continue a 'top-down' approach, but how to optimize this system. There is a plethora of findings that offer insights on how to fine-tune this innovation approach, and doing so offers great potential in enhancing innovation capabilities. The potentially greatest challenge China's innovation system faces is the regional disparity. Only one-fifth of China's regions seem to be performing efficiently in the innovation system and there is evidence for regional externalities, where richer regions drain the absorptive capabilities of poorer regions. There are key policy measures to be implemented in order to improve the regional disparity, such as education programs and policy inhibiting the absorption of innovative potential from neighboring areas.

From an organizational perspective, evidence shows that firms engage in strategies that seek to improve innovation capabilities. Knowledge acquisition and particularly collaboration seem to be particularly frequent practices. As collaboration is a relatively new trend in the innovation stream of research, the high frequency of collaboration practice in Chinese firms suggests that Chinese firms' strategies are quite modern. In general, it can be said that Chinese firms show a high incentive and capability to innovate.

One major weakness that is visible within this research is the lack of link between academia and the rest of the innovation system, both from a theoretical and a practical perspective. As a significant stakeholder in the national system of innovation, academia can positively influence the innovation levels of an economy, and the Chinese government seems to realize this due to their link with the Chinese Academy of Sciences. It is advisable to increase both the practical links with academia, and increase the theoretical research on this subject.

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Another major theoretical gap is the link between individuals and innovation. Merely two papers were found on this subject, and they display promising findings. Research here is needed in order to better understand the individuals' role in the innovation system. Hackerspaces offer a great opportunity here. Being a relatively new trend, the number of hackerspaces has grown greatly in the last five years, and the creation of these has seemingly lead to innovation activity. There is therefore a great need to research the impact these are having on innovation as a whole.

Limitations

Even though this SLR was written in the most disciplined manner possible there are some clear limitations. The articles reviewed in this SLR were solely SSCI English language articles. Whilst this guaranteed a high academic quality, it also excluded non-indexed journals as well as all non-English journals. Since the topic is heavily China focused this is a clear limitation as all Chinese written articles were excluded. Furthermore, the article was written in the format of an SLR, in order to allow for transparency and replicability, yet there was still unavoidable subjectivity in choosing categories and in data analysis.

Conflict of interest statement

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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