



Aalto University
School of Business

Enabling the effective open innovation in Business Ecosystem: A case study of Chinese catch-up firm Huawei

Bachelor's Thesis
Qian Lin
12.05.2017
Business Technology

Approved in the Department of Information and Service Economy xx.xx.20xx
and awarded the grade

Table of Contents

1. Introduction to the research background and motivation

- 1.1 Research background and motivation
- 1.2 Research objectives and methodology

2. Literature review

- 2.1 Introduction of Business ecosystem
 - 2.11 Understanding the definition of business ecosystem
 - 2.12 Dynamics of business ecosystem
 - 2.13 Strategy in business ecosystem
- 2.2 Introduction to open innovation
 - 2.21 Understanding innovation and the transition from closed to open innovation
 - 2.22 Open innovation paradigm and definition
 - 2.23 Strategically managing open innovation modes
 - 2.24 Knowledge management in open innovation
- 2.3 Summary of healthy and effective open innovation ecosystem framework

3. Analysis of Chinese catch-up ICT firm Huawei's open innovation in business ecosystem

- 3.1 Evaluate Huawei's business ecosystem stage development
- 3.2 Identify Huawei's business ecosystem players
- 3.3 Assess Huawei's ecosystem strategy
- 3.4 Evaluate Huawei's open innovation mode and strategy
- 3.5 Explore Huawei's knowledge management
- 3.6 Discuss Huawei's innovative leadership briefly

4. Challenges and risks in globalization

5. Key findings and implications

6. Bibliography

1. Introduction to the research background and motivation

1.1 Research background and motivation

As the prevalence of globalization, rapid technology development and rapid market changes, ICT industry is competitive and dynamic. ICT business enterprises face tremendous challenges internally and externally. While it is well-recognized that ICT sector is crucial to bring social and economic transformations and innovation is a key strategy for business enterprise and nation to gain competitiveness, however, there might be numerous biases and misunderstandings towards how to implement innovation process, how to establish effective innovation ecosystem and consequently integrate innovation into business strategy for creating value and achieve social, economic progress.

Successful innovation requires deliberate strategy. Innovative business can't rise up alone without considering its connections and impacts on other actors in the ecosystem. As Li suggested (2009), business can create much value through a healthy ecosystem in order to face the fierce competition beyond the issues of R&D—intensive, higher value added, shortening life-cycle, and globalization. Therefore, business ecosystem's approach can be interpreted as an indispensable strategy for firms to gain competitive advantage. Furthermore, instead of focusing on limited scale on business' value chain, business ecosystem approach is based on comprehensive ecological perspective. The term of business ecosystem can be broadly defined as dynamic and co-evolving communities of diverse actors who create and capture new value through increasingly sophisticated models of both collaboration and competition (Kelly, 2015). Specifically, from ICT industrial's perspective, ICT Ecosystem encompasses the policies, strategies, processes, information, technologies, applications and stakeholders that together make up a functional environment for a country, government or an enterprise (Diga and May, 2016). Thus, business ecosystem perspective suggests firms take holistic approach and involve direct or indirect actors in the ecosystem into the innovation process and to exploit the external knowledge, technology and talents.

Interestingly, the concept of open innovation has become one of the hotly debated topic regarding to innovation management filed nowadays with Google search over 21 million results. The father of open innovation, Chesbrough (2003) defined the concept of it as: *The use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. Open innovation is a paradigm that assumes that firms can and should use external ideas, as well as well as internal ideas, and external and internal paths to*

market, as they look to advance to technology. From Chesbrough's perspective, it is critically important for business enterprises to synergize the innovation internally and externally. Thus, open innovation addresses the importance of collaborations in the business ecosystem and therefore leverages the innovative capability for business enterprises.

Based on the concept of business ecosystem and open innovation framework, Chinese ICT company Huawei will be used as my case study. Main reasons are as below: First, there are relatively limited researches discussing open innovation in the context of the business ecosystem from a student's perspective. Second, many innovation or ICT ecosystem related empirical topics, cases studies and experiences are from developed countries. Stereotypically, China is regarded as world of factory instead of being tagged with innovate. According to McKinsey's report, Chinese ICT industry is more innovative and dynamic than generally assumed and there are significant innovation progresses in Chinese emergent ICT industry. As McKinsey's report suggests (2015), the Chinese model of innovation may be applied to other developing countries as well who wish to make the transition in the business ecosystem.

Third, established in 1987, as Chinese indigenous ICT Firm, Huawei has archived remarkable progress globally. Covering over 170 countries and regions, Huawei is the one of the world's largest telecommunications equipment manufacturer. The revenue for Huawei is around CNY 245 billion annually in 2016. Not surprisingly, according to Thomson Reuters Derwent World Patents Index, Huawei along with the Samsung, are the most innovative top 10 firms in the telecommunications industry globally (Burkitt-Gray ,2016). Yet, compared the Giant peers as Samsung, Apple, Nokia, as a latecomer, Huawei has its weakness and limitation. Nevertheless, Open innovation has played critically important role in Huawei's business. Moreover, there are certain risks and challenges Huawei faces in the era of ICT ecosystem and globalization. For example, how to retain the competitiveness for long term?

1.2 Research objectives and methodology

This thesis explores what role the open innovation ecosystem plays in the Chinese catch-up ICT firm. The objective is to investigate what are effective strategies in the open innovation, from the business ecosystem's perspective. I conduct the research which is mainly focusing on qualitative methods as literature reviews and case studies. Secondary data such as white paper, research paper and annual reports are also collected for qualitative analysis. First, literature reviews regarding to the definition,

dynamics, strategy of business ecosystem will be discussed in chapter 2. Consequently, the concept of innovation and the transitions, open innovation definition and aspects regarding to managing open innovation modes, knowledge management will be stated and analyzed in second part in chapter 2. Chapter 3 will securitize Chinese catch-up ICT firm open innovation with empirical case studies of Huawei and at last chapter 4 I will carefully draw the conclusion and implications. The main research questions are addressed as blow.

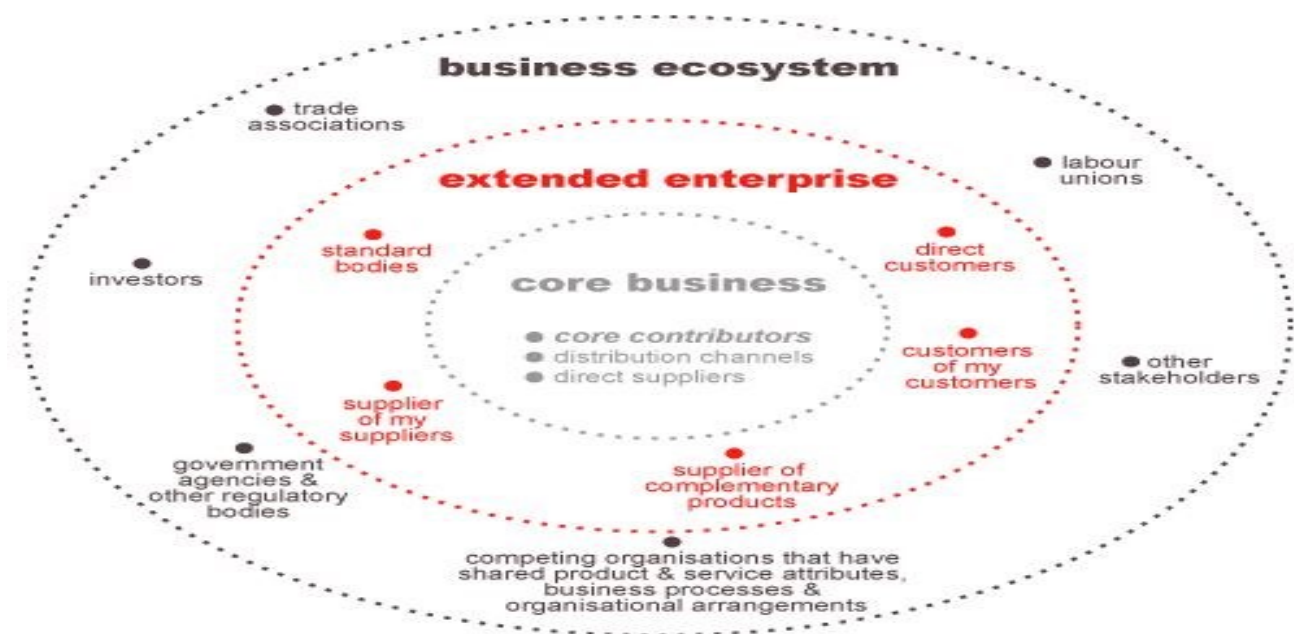
- How to enable the effective open innovation in business ecosystem? What are strategies?
- How has Huawei established its open innovation ecosystem and enhanced its competitive advantages through open innovation?
- What are the risks, challenges and implications for Huawei and other Chinese ICT firms in the era of globalization?

2.1 Introduction of Business ecosystem

2.11 Understanding the definition of business ecosystem

The concept of business ecosystem was introduced by business strategist James Moore. As he vigorously challenged (1993), *company shall be viewed not as a member of a single industry but as part of a business ecosystem that crosses a variety of industries. In a business ecosystem, companies co-evolve capabilities around a new innovation: They work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations. Figure 1 demonstrate the Business ecosystem model as Moore proposed.*

Figure 1. Business ecosystem model (Moore,1993)



Surprisingly, Moore took a comprehensive ecological approach in the context of business. From Moore's perspective, business ecosystem includes various actors. Admittedly, Moore acknowledged the importance of networking for business, nevertheless, he urged managers to take a transformative ecological approach. Additionally, he emphasized it's the competition that has catalyzed the

technological transformation in the business ecosystem and he argued that firm shall establish its novel business community on a broader scope by collaborations and competitions that brings innovations to the market successfully. Thus, from Moore’s perspective, business ecosystem contains main elements as customers, suppliers, markets, competitors, government, society, products and other stakeholders.

Moreover, in order to adapt the successful business ecosystem, its critically important to comprehend the four evolutionary stages of business ecosystem which includes the elements of birth, expansion, leadership and self-renewal, as shown in Table 1. Following that, firm shall develop its own strategy in accordance with its stage.

Table 1. The evolutionary stages of ecosystem (Moore,1993)

The Evolutionary Stages of a Business Ecosystem		
	Cooperative Challenges	Competitive Challenges
Birth	Work with customers and suppliers to define the new value proposition around a seed innovation.	Protect your ideas from others who might be working toward defining similar offers. Tie up critical lead customers, key suppliers, and important channels.
Expansion	Bring the new offer to a large market by working with suppliers and partners to scale up supply and to achieve maximum market coverage.	Defeat alternative implementations of similar ideas. Ensure that your approach is the market standard in its class through dominating key market segments.
Leadership	Provide a compelling vision for the future that encourages suppliers and customers to work together to continue improving the complete offer.	Maintain strong bargaining power in relation to other players in the ecosystem, including key customers and valued suppliers.
Self-Renewal	Work with innovators to bring new ideas to the existing ecosystem.	Maintain high barriers to entry to prevent innovators from building alternative ecosystems. Maintain high customer switching costs in order to buy time to incorporate new ideas into your own products and services.

2.12 Dynamics of business ecosystem

At a later stage, Deloitte university press furnished the definition of business ecosystem. Table 2 summarizes features of the definition of business ecosystem. According to Kelly’s Deloitte’s report (2015), the economy has been moving beyond narrowly defined industries built around large, vertically integrated, and mainly “self-contained” corporations. New means of creating value have

been developing everywhere in the form of ever-denser and richer networks of connection, collaboration, and interdependence. Similarly, business ecosystem suggests broader scope of engagements, regardless the organization or individual. Second, it implies a flat, symbolic and dynamic trend which stimulate the productivity, knowledge sharing and innovation. In addition, multiple forms of networking provide new ways of value creating. Not surprisingly, former CEO of Nokia vehemently emphasized "The battle of devices has now become a war of ecosystems..." (Zigler,2011). This suggests the imperativeness of understanding and utilizing the dynamics of business ecosystem.

Table 2. Definition of business ecosystem (Kelly ,2015)

Figure 1. Defining business ecosystems

<p>Ecosystems are dynamic and co-evolving communities of diverse actors</p>	<p>Ecosystems typically bring together multiple players of different types and sizes in order to create, scale, and serve markets in ways that are beyond the capacity of any single organization—or even any traditional industry. Their diversity—and their collective ability to learn, adapt, and, crucially, innovate together—are key determinants of their longer-term success.</p>
<p>who create and capture new value</p>	<p>Enabled by greatly enhanced connectivity across specialized capabilities and resources, ecosystems develop new, co-created solutions that address fundamental human needs and desires and growing societal challenges. While forging superior ways to create new value, ecosystems also increase the importance of discovering new business models to capture that value in a world of commoditization and “de-monetization.”</p>
<p>through both collaboration and competition</p>	<p>Competition, while still essential, is certainly not the sole driver of sustained success. Participants are additionally incentivized by shared interests, goals, and values, as well as by the growing need to collaborate in order to meet increasing customer demands, to invest in the long-term health of their shared ecosystem, from which all can derive mutual benefit.</p>

Source: Deloitte analysis.

Graphic: Deloitte University Press | DUPress.com

The case reported here illustrates the distinct characteristics of the business ecosystem (Kelly,2015).

- **Creating new ways to address fundamental human needs and desires**
- **Driving new collaborations to address rising social and environmental challenges**
- **Creating and serving communities, and harnessing their creativity and intelligence**

- **Existing on top of powerful new business platforms**
- **Accelerating learning and innovation**

Those characteristics of business ecosystem imply some certain advantages for innovation. First, Deloitte's impressive analysis emphasize the importance of fundamental principle – humanity based. Second, ecosystem thinking can help us to reflect the profound and symbiotic relationships among business, human beings and nature (environment) and raise up our awareness of the imperativeness of mitigating the social, environmental challenges. Third, its synergized effect spurs knowledge creating and sharing, and consequently stimulates innovation. Fourth, as Iansiti and Richards (2006) pointed, the platform providers perform a critical role in an ecosystem generally enhancing innovation and productivity. Last, it suggests the collaborative efforts for innovation. As Li (2009) pointed out, for example, Cisco Systems has been so successful in utilizing its strategy of mergers and acquisitions for corporate growth based on a business ecosystem.

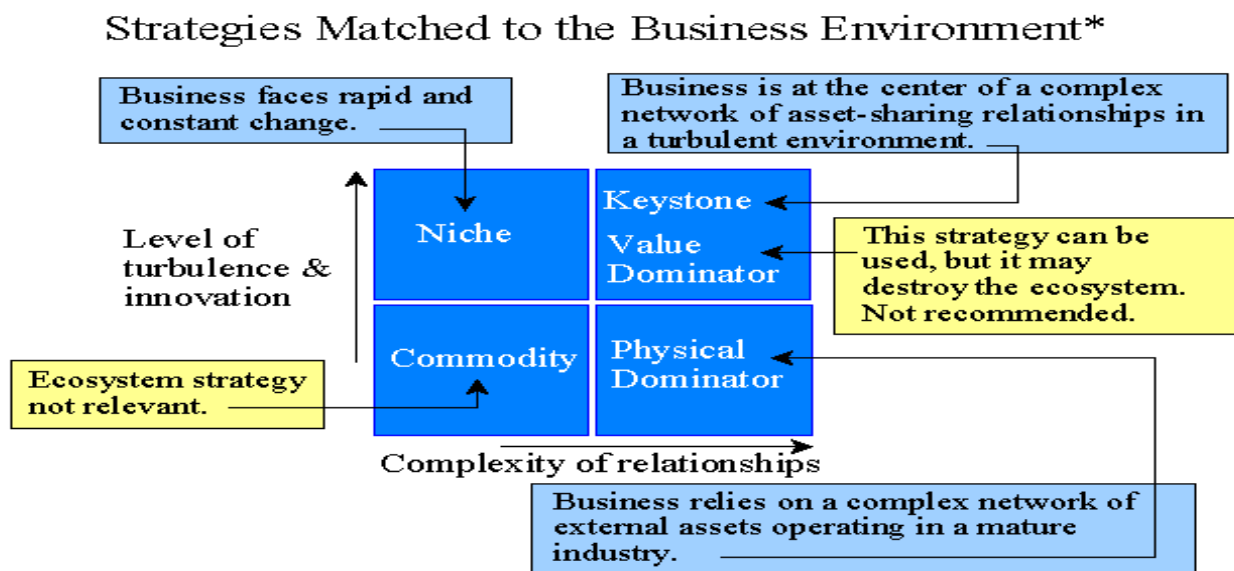
2.13 Strategy in business ecosystem

Furthermore, interestingly, the analogy between business and ecology has also drawn many other scholars' attentions. Another key concern is how to define the health business ecosystem in the complex business circumstances. As Iansiti and Levien emphasized (2004), business networks and biological ecosystems are both characterized by a large number of loosely interconnected participants who depend on each other for their mutual effectiveness and survival. If the ecosystem is healthy, individual species thrive. If the ecosystem is unhealthy, individual species suffer. Therefore, its critically important to pay attention to the concept of health business ecosystem.

According to Iansiti and Levien (2004), three crucial characteristics of health business ecosystems are productivity, robustness, and niche creation. First, productivity can be understood simply as the achievements of firm in the means of financial, production level or technological performance and it can be measured by ROIC (Return on invested capital). Second, the robustness highlights the competitiveness of the firm through the synergized effects in the network which can be measured by the number of ecosystem players. Third, niche creation implies the ability to crating more value through various means and the measurement of niche creation is based on variety via value creation in ecosystem.

Likewise, Iansiti and Levien (2004) pointed that the strategy shall be based on the firm's position in the business ecosystems, which includes keystones, physical dominator, niche and commodity. Figure 2 is an illustration of how firm shall match its strategy to the corresponding business environment. Accordingly, by creating value and sharing value with other actors, keystone influence business ecosystem significantly. For example, google 's android operating system is keystone type. Ironically, dominator is downplayed since it doesn't contribute equivalent value back to the ecosystem while extracting value. Interestingly, most firm follow the strategy as Iansiti and Levien (2004) stressed. The relationship is not static, therefore firm shall adjust its strategy accordingly to its position.

Figure 2. Matching strategy to the environment (Johnson,2004)



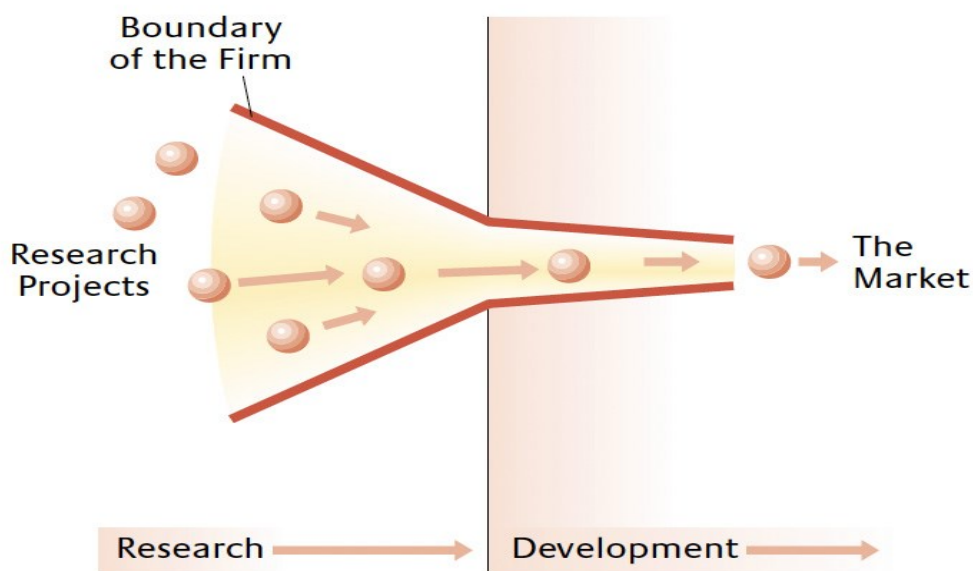
2.2 Introduction to innovation

2.21 Understanding innovation and the transition from closed to open innovation

Nowadays Its well-recognized that innovation is key factor to gain competitiveness advantage. As Porter (1990) pointed out, Companies achieve competitive advantage through acts of innovation. They approach innovation in its broadest sense, including both new technologies & new ways of doings things. Yet, successful innovation requires strategic management and process implementation.

In a long time, it was well established belief for firms to foster innovative ideas and implement them into production by heavily investment in R&D internally. Such inward approaches can be called closed innovation as Figure 3 indicates. Chesbrough (2003) pointed out, closed innovation is self-alliance which firm seeks firstly to erect barriers to entry facing potential competitors and can be described as a closed funnel in which some of the internal research projects started by the company end up as new products after a careful vetting process. Similarity, closed innovation process relies on internally the investments of R&D and capability of technology and knowledge of the firm. In addition, closed innovation model suggests completions among the firms instead of collaborations broadly in the business ecosystem.

Figure 3. Closed innovation model (Chesbrough,2011)



Closed innovation has yielded significant success historically. Chesbrough (2003) saluted the achievements through closed innovation historically. However, it's not sufficient for firms to focus on internal approaches and innovative ideas exclusively from internal not necessarily gain success in markets.

Although Chesbrough acknowledges the achievements from closed innovation model approach, he argues that several factors have diminished the closed innovation paradigm as the knowledge shifts dramatically nowadays. As Chesbrough pointed out (2003), the main determinants include the

enlarging professional workforces with more arability and mobility, the escalating venturing capital market, external options for commercializing ideas and the influences of external suppliers' capabilities. Table 3 elucidates the erosion factors of the closed innovation paradigm. First, this implies the closed innovation's perspective is based on limited scale in the context of dynamic and fast moving business circumstance. Second, the erosion factors also indict the breakage of the exclusively internal focusing on R&D. More importantly, they suggest the diversities of the innovation resources both internally and externally. Moreover, as Chesbrough (2003) emphasized, the erosion factors have rearranged the landscape of knowledge. Therefore, those changes cast doubts on the closed innovation model and call for attentions on the way how knowledge is created, distributed and accessed.

Nevertheless, it doesn't mean all the firms shall transform to open innovation model. Admittedly, Chesbrough emphasized (2003) that different business can be located on continuum, from essential closed to completely open. for example, it's still questionable for some industry as unclear filed will ever transform into open innovation model.

Table 3. The Erosion factors of the Closed Innovation Paradigm (Chesbrough, 2003)

Erosion Factors
The increasing availability and mobility of skilled workers made it difficult for firms to control their expertise and proprietary ideas
The growing venture capital market has helped to finance new firms and commercialize ideas spills outside the research labs
As product life cycles shorten and as external options grow, it becomes increasingly important for firms to increase the metabolic rate at which they process knowledge
The increasing presence of capable external suppliers is a double-edged sword for large companies with extensive internal R&D investments

2.22 Open innovation paradigm and definition

The core of open innovation paradigm is on the ground of the knowledge shift in the dynamic technological development and business circumstance. Chesbrough (2003) pointed out the rapid

knowledge diffusion reflects the end of knowledge monopoly and the abundance of knowledge is not limited as the world of internet is prevalent. Consequently, the closed, self-alliance approach reflects the dismissing of the abundance of external knowledge, which may result negative consequences for the firm. Particularly, Chesbrough (2003) emphasized the innovation process is completely reversed in the open innovation model, in addition, successful firms as IBM and Merck, which prospered in the closed innovation regime, are broadening their approach from traditional R&D approach to external, open innovation model.

Equally, as figure 4 illustrates, Chesbrough (2003) defined Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. This paradigm assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology. Also, Table 4 clarifies the main differences between the concepts of closed and open innovation. Thus, compared to closed innovation, open innovation's approach is more holistic and it suggests the innovative ideas, sources are more dynamic and multifaceted. The advantages of open innovation can be defined as below:

- Flexibility in adsorbing the knowledge internally and externally
- Adding more value to the whole chain
- Reducing the risks and costs
- Spurring the knowledge creating and sharing
- Enhancing firm's capability in innovation process
- Raising the awareness and concern regarding to intellectual property control
- Expanding new markets

Furthermore, open innovation implies the creation, distribution and the implementation of knowledge into product and service can be collaborated with internal and external actors in the ecosystem as employees, universities, research institutes, government, suppliers, customers, business partners, and even competitors. Yet, it also requires the capability of firms to identify, create, distribute the knowledge, technology and utilize them into value chain in the business network.

Figure 4. Open innovation paradigm (Chesbrough, 2003)

Open innovation

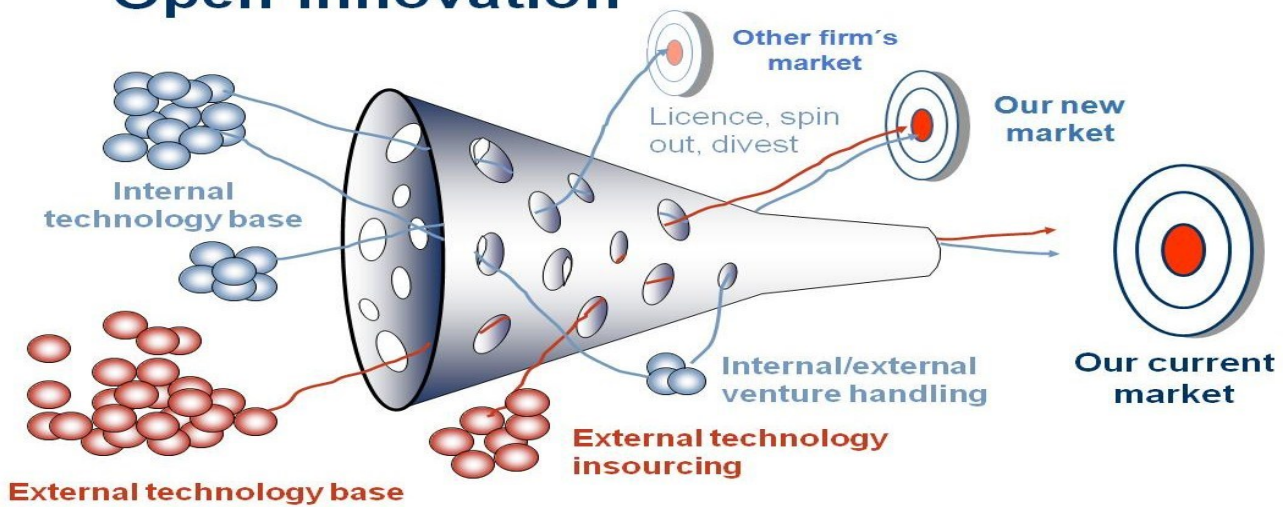


Table 4. Contrasting principles of Closed innovation and Open innovation (Chesbrough, 2003)

Closed innovation	Open innovation
The best people work in our enterprise	Not all the best work in our enterprise. We have to work with knowledgeable people both internal and external
To benefit from R&D we need to invent, develop, nurture and commercialize innovations based on work done in our enterprise	External R&D has the capability to produce significant value .Internal R&D is needed to capture part of that value
If we invent the innovation, we are the first to bring it to the market	It is not necessary for us to be initiator of an innovation to benefit from it
That enterprise will win which enters the market first	It is more important to build a better business model than to be the first in the market
We will win, if we create more of the best ideas in our industry than our competitors	We will win, if we create the best possible combination of internal and external ideas
We need to control our intellectual property so that our competitors are not able benefit from our ideas	We should gain profit from others using our intellectual property and we should buy intellectual property from others when that supports our business

2.23 Strategically managing open innovation modes

Nevertheless, open innovation doesn't indicate the denying of the role of R&D, neither completely rely on external knowledge, technology or resource. Instead, the role of R&D is considered broadly in the context of more open circumstance. However, open innovation is associated with complexities since many actors are involved in the context of business ecosystem.

Another critically important factor in the open innovation is the understanding and managing innovation modes. It's crucial for firms to develop its own particular strategy and to open the innovation process according to the innovation modes. Bagherzadeh, et al., (2016) argued, despite the concept of open innovation has caught numerous attentions, nevertheless firms need strategy towards open innovation process and synergy the R&D internally and externally. In addition, different types of innovation projects require different modes of operation to manage the knowledge sharing, uncertainty and ambiguity involved in any open innovation activity. As Accenture and the Research Center for Open Digital Innovation at Purdue University found out, Figure 5 indicates four basic open innovation modes and figure 6 demonstrates how to choose the right mode according to its own condition correspondingly.

Figure 5. Basic archetypes and features of open innovation modes (Bagherzadeh, Narsalay, Yu and Brunswicker, 2016)

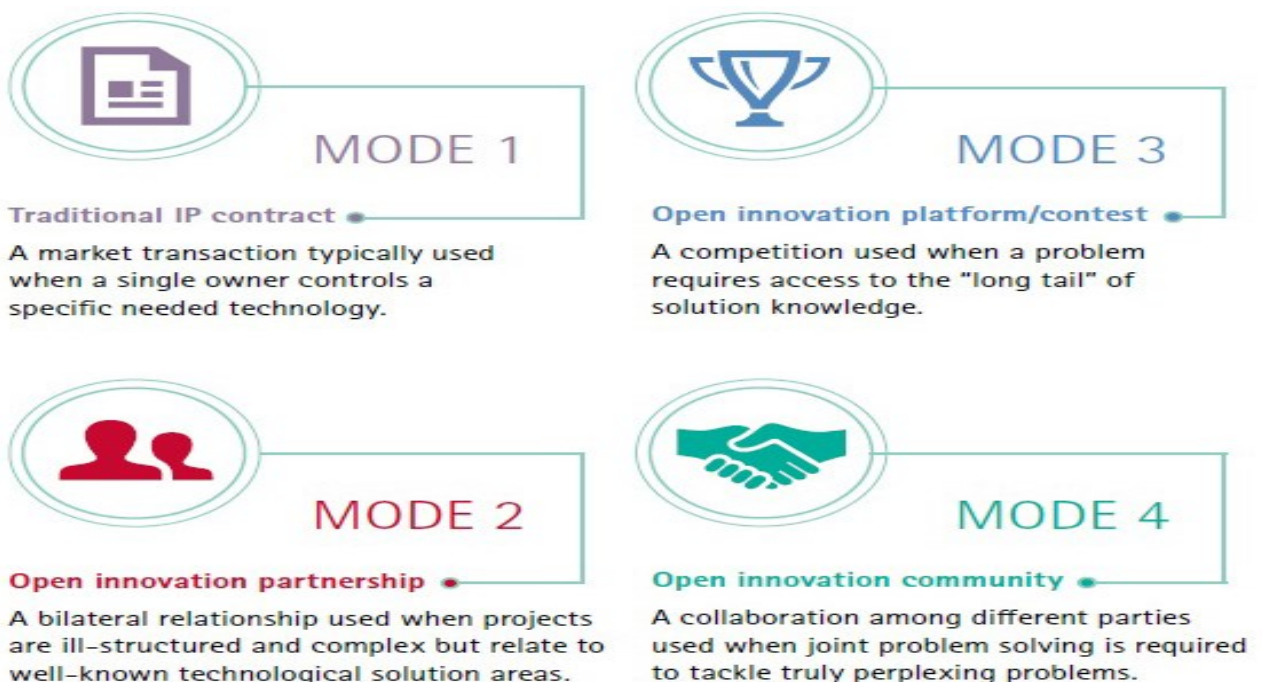


Figure 6. The right mode for right conditions (Bagherzadeh, Narsalay, Yu and Brunswicker, 2016)

	MODE 1 TRADITIONAL IP CONTRACT	MODE 2 OPEN INNOVATION PARTNERSHIP	MODE 3 OPEN INNOVATION PLATFORM/CONTEST	MODE 4 OPEN INNOVATION COMMUNITY
Communication channels	Limited	Strong	Limited but wide	Strong and wide
Incentives	High	High	Moderate	Low
Control over IP	Owned by external partners	Negotiable between firm and external partners	Owned by firm	Usually owned by firm
Knowledge sharing	Limited	Strong	Limited	Strong
Access to external partners	Limited	Limited	Strong access to wide range	Strong access to wide range

Figure 6 shows the strengths and limits of each modes and consequently this suggests there are no strict boundaries among those innovation modes, therefore firms may adjust its mode according to its particular situation flexibly. Similarly, each mode has its advantages and disadvantages, thus, firm can use the combination of modes to mitigate the risks and synergy the open innovation.

2.24 Knowledge management in open innovation

The effective knowledge management is also one of the essential component for the success in open innovation ecosystem. The modern technology has changed how the knowledge distributed and nowadays the economy landscape is highly intensive knowledge based. The competitiveness of a firm in a dynamic business environment depends on the competitive quality of its knowledge-based assets and the successful application of these assets in operational activities in order to fulfil its strategic objectives (Teece et al., 1997). Thus, its critical for firms to enhance its capability in accessing, absorbing the knowledge, technology, information and utilizing for its core competitive advantage internally and externally.

Yet, on the other hand, due to the nature of open innovation, knowledge sharing, technology and expertise among partners also exposes the risk of leakage of such assets and free-riding if not managed

effectively (European IPR Press ,2015). For example, there might be hidden uncertainties and risks due to the leakages of company's inventions and know-how to its competitors. Thus, in order to ensure the explicated ownership and protection of knowledge, firm must engage in selective sharing with partners, licensing some registered and unregistered IPRs, while opting to keep other information. (Brant and Lohse,2014). One possible implication of this is that firm should take effective approach in managing intellectual property which is incorporated with innovative process. In addition, patents application and is one of the main attributors which protects the knowledge and stimulate the commercialization of the innovations. As Brant and Lohse (2014) stressed, at the market level, patent can be used to signal market potential of the patent holders' innovations which can help firms to identify potential beneficial knowledge, technologies, partners and collaborations and further at facilitate technology and knowledge transfer via licensing and other negotiated contracts or legal arrangements. This is also crucial for firm to solidifying its position and enhancing ng the reputation and furthermore knowledge management is constructive and strategic for firm in building healthy and fair innovation ecosystem.

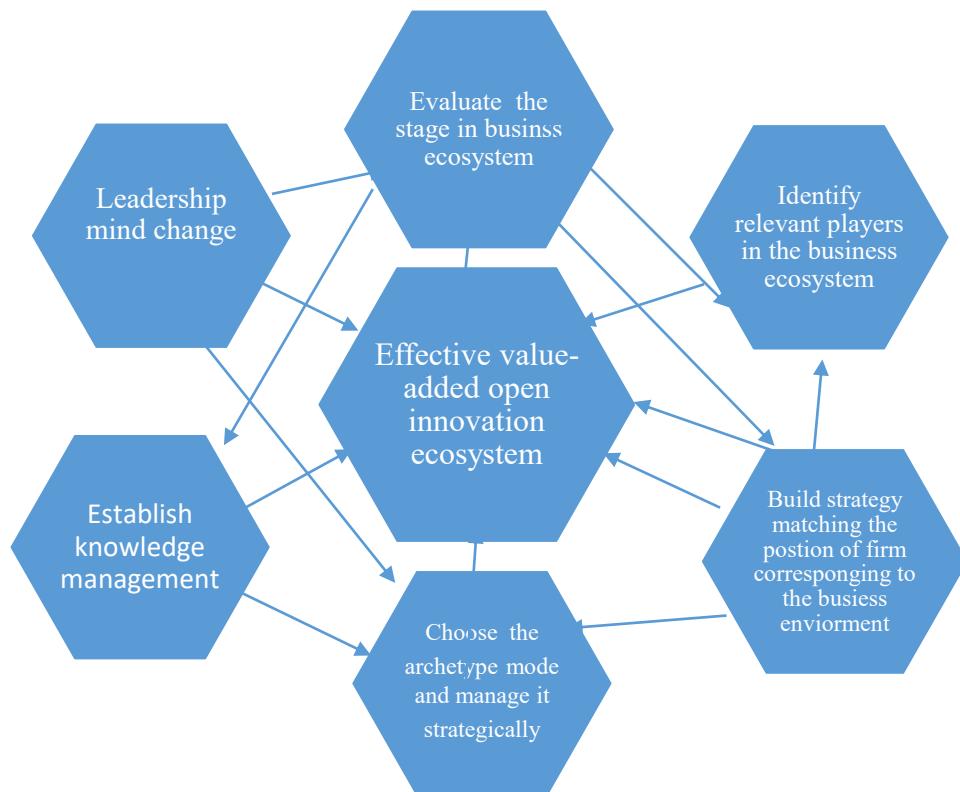
2.3 Summary of healthy and effective open innovation ecosystem framework

Thus far, according to on those conceptual frameworks and literature reviews as in the previous chapters discussed, I have drawn some tentative proposition regarding to open innovation ecosystem which includes 6 elements as Figure 10 shows. The finding of this report suggests that open innovation ecosystem can be interpreted as business strategy: cooperative and competitive business ecosystem which includes key suppliers, customers, government, organization, society, competitor's other stakeholders and knowledge, market that synergy the innovation internally and externally.

In summary, there are interactive and synergistic relationships among those elements which boost the open innovation in the business ecosystem. In order to achieve the effective, value added open innovation in the healthy business ecosystem, organization shall be aware of the concept and features of business ecosystem and the elements of its business domains. Besides, organization need to evaluate its own evolutionary stage in the business ecosystem and correspondingly mitigate the changes. Consequently, it's important for organization to identify the relevant players and choose relevant strategy based on the level of turbulence and the relationship with other actors in the business ecosystem. In the context of open innovation, it's crucial for firms to develop its own particular strategy and to open the innovation process according to the innovation modes. Specifically,

knowledge management in the context of open innovation is one of the key for success. In addition, leadership also plays essential role in establishing the effective open innovation ecosystem.

Figure 7 . Open innovation through collaboration and competition in the fair, health business ecosystem



3. Analysis of Chinese catch-up ICT firm Huawei’s open innovation in business ecosystem

Following the framework proposed as in chapter 2, I will use this tentative framework to securitize Chinese catching-up ICT firm open innovation with empirical case studies of Huawei to illustrate how the latecomer firm from developing country has built up its competitiveness in the global market and what are strategies in the open innovation ecosystem. The aim is also to highlight the relevant players in Huawei’s open innovation ecosystem and to identify the approaches how has Huawei enhanced its open innovation capability in the context of business ecosystem. Furthermore, I will also analyze how Huawei’s knowledge management in the context of open innovation ecosystem and discuss the challenges and implications in the era of globalization.

Established in 1987, with capital roughly around USD 5700, Huawei has achieved globally operational success with annual revenues USD 39 billion in 2016. As one of the leading ICT solution provider in Global Fortune 500, Huawei has actively participated in open innovation ecosystem by providing enterprise networks, devices, cloud technology and other services over 170 countries. According to Finnish Funding Agency for Innovation Tekes's report (2015), currently it has over 150,000 employees and 45% of whom are engaged in R&D, 6 supply center, 23 R&D centers covering China, US, Germany, UK, France, Italy, Finland, Russia, India, Sweden and so on, 36 shared service centers, 45 training centers. As its core value indicates: Building better world, Huawei has innovated continuously to focus on customers need and to stabilize the leadership in the technological field.

3.1 Evaluate Huawei's business ecosystem stage development

Following the framework as Figure 7 illustrates, the first step is to analyze Huawei's business ecosystem stage. I have summarized the 3 stages of its development in business ecosystem chronologically as below indicate.

- **Huawei's Birth Stage (1987-1997)**

At the birth stage, in order to create value and prevent the competitors, its critically important for firm to focus on the key customers and collaborate with key suppliers and other stakeholder. Huawei was relatively small startup firm when it was established in 1987 as sales agent dealing Private Branch Exchange business. As the new comer in the ICT filed, Huawei was aware of its limitation and challenges and prevented the competitor from same market segments by taking the right approach towards the customer and suppliers to define the value proposition. Later on, Huawei initiated its implementations in R&D centers in Beijing and Shanghai and launched some remarkable technology solutions to focus on limited customer groups such as small business enterprises, customers from Chinese rural areas. In addition, Huawei was able to gain considerable supports from Chinese government and Chinese financial institutions. During the birth stage, Huawei had relatively small amount of customers, market, key suppliers and other stakeholders within limited business scope.

- **Huawei's Expansion Stage (1998-2011)**

At the second stage, firm will expand its business scale and scope by enlarging partnerships among various actors in the ecosystem. Accordingly, increasing ecosystem actors such as new supplier, customers, competitor, partners will participate the co-evolving and dynamic business network. Thus, firm is able to provide bigger range of value added new products or service. The strategic collaborations among various ecosystem players is vital to synergy. With initial success in Chinese rural areas, Huawei expanded its business to Chinese urban cities in 1998 with cheaper, solid quality products. In the consequent years, Huawei has gradually expanded its business from domestic into global emerging markets. In addition, Huawei has established its oversea R&D centers in Asia, Europe and North America. This reflects Huawei's strategy in building highly customer focused and localized innovation cluster. During this stage, Huawei has established its joint venture innovation and research programs with various global influential firms such as IBM, Siemens, British Telecom, Motorola and so on (Hensmans,2017). Furthermore, Huawei has heavily invested in R&D and enhanced its innovation power by encouraging patents application in long term, which indicates the reinforcement of the competitive innovation capability. The collaboration and competitions among Huawei and the dominant global competitors suggest the mutual interest and shared value in promoting the long term healthy innovation ecosystem and Huawei's commitment in creating open innovation ecosystem. This strategic global cooperation with numerous suppliers and partners has also assisted Huawei to solidify its market position and strengthen its value chain.

- **Huawei's Mature Stage (2012- Present)**

As Zhang (2009) points out, the success in catching-up firm is labeled by increasing market performance the enhanced innovation capability. Since 2012, Huawei has expanded its operation significantly over 170 countries serving over 3,5 billion customers with the business areas in carrier network, enterprise solutions and consumer service and products. Huawei has consolidated its role in global open innovation ecosystem by establishing multiple R&D centers, continuously investment in open innovation process, patent application, IPR protection and actively participating 177 open source organizations and so on. At this stage, Huawei has achieved stable and significant financial performance as The figure 8 and figure 9 illustrate.

Furthermore, Huawei has also actively promoted the industrial technology by intensively customer focused innovation progress towards on 5G, Internet of things, Big data, Cloud computing and so on. For example, by2015, Huawei shipped more than 100 million smartphones and was ranked No. 3 in

2015 global smartphone market, following by Samsung and Apple. Significantly, Huawei has continuously invested over 10% of revenue into R&D and in the past decade amounted to US\$24.9 billion. Over 45% of the Huawei's nearly 170,000 employees are involved in R&D (<https://www.eifonline.org>). During this stage, according to Liu's analysis (2016), Huawei's Return on the invested capital (after tax) achieved 21.6% in 2014, which suggested its robust productive capability in creating value in the business ecosystem.

Figure 8. Huawei's financial performance highlight (Huawei, 2015)

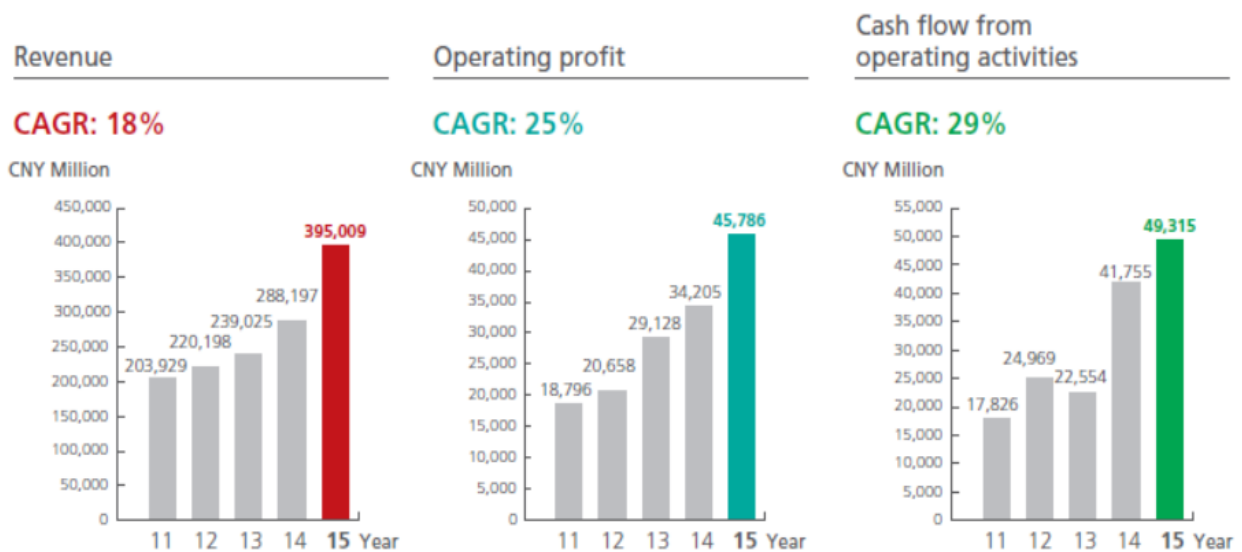
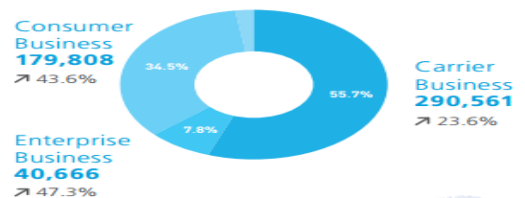


Figure 9. Huawei's business review 2016 (Huawei Annual Report, 2016)

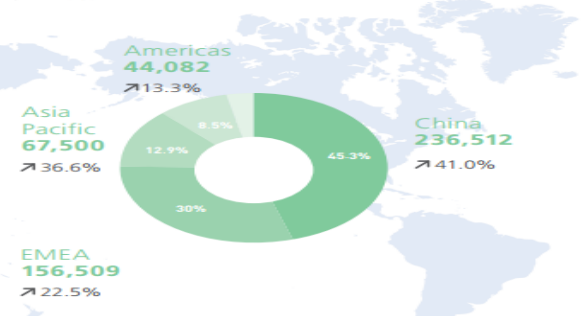
Business Review 2016

In 2016, we maintained our strategic focus, continued making breakthroughs, and created real value for our customers. Our annual revenue was CNY521,574 million, up 32.0% year-on-year.

(CNY Million)	2016	2015	YoY
Carrier Business	290,561	235,113	23.6%
Enterprise Business	40,666	27,610	47.3%
Consumer Business	179,808	125,194	43.6%
Others	10,539	7,092	48.6%
Total	521,574	395,009	32.0%



(CNY Million)	2016	2015	YoY
China	236,512	167,690	41.0%
EMEA	156,509	127,719	22.5%
Asia Pacific	67,500	49,403	36.6%
Americas	44,082	38,910	13.3%
Others	16,971	11,287	50.4%
Total	521,574	395,009	32.0%



3.2 Identify Huawei's business ecosystem players

The second step according to the framework is to identify the relevant business ecosystem player in Huawei's case. As discussed in the evaluations of Huawei's ecosystem stages, it can be inferred that Huawei has involved with multifaceted ecosystem players such as direct suppliers, core contributors from core business, direct or indirect customers, suppliers from second layer extended enterprise and investors, government, competitors or partners and other stakeholder in broad context of business ecosystem. The collaborations and competitions in business ecosystem has created added value which also spurs the creativities and intelligences. It can be found that Huawei's business ecosystem players are multifaceted and dynamically co-evolving as the figure 10 demonstrates.

Figure 10. Huawei's ecosystem in practice (Huawei Annual Report,2016)

Ecosystem in Practice: What Huawei is Doing

Industry alliances Growing the industry together	<ul style="list-style-type: none">Co-founded the 5G Vertical Industry Accelerator (5GVIA) in Munich, Germany – a large-scale testbed for testing and verifying 5G application scenarios for different verticals.Initiated the Edge Computing Consortium (ECC) – a platform to drive the convergence of OT and ICT in the edge computing industry.Proposed the NB-IoT standard for low power wide area connections, and drove the formation of the NB-IoT Industry Forum with GSMA (now with 50+ members).Member of the Industrial Internet Consortium (IIC) in America and the Alliance of Industrial Internet (AII) in China.Key member of the eLTE Industry Alliance and the SDN/NFV Industry Alliance.
Strategic partnerships Enabling customer success	<ul style="list-style-type: none">Supported Deutsche Telekom's launch of Open Telekom Cloud.Partnered with SAP to establish a joint innovation center and develop Industry 4.0 solutions.Partnered with Intel on solutions to improve network performance, including chip development and SDN.Founded the Max Berek Innovation Lab with Leica to support joint R&D.
Open source communities Promoting open and integrated innovation	<ul style="list-style-type: none">Elected as OpenStack Gold Member Board Director in 2016, now a Platinum member in 2017; chosen as project team lead (PTL) for six OpenStack projects, and a core member of 21.Donated CarbonData format to Apache Software Foundation – an original file format designed to speed up big data queries (unanimously approved for further incubation).Key contributor to open source ICT communities like ONOS, OPEN-O, OPNFV, CNCF, OCI, and Docker.
Developer support Enriching the ecosystem	<ul style="list-style-type: none">In 2015, announced a five-year Developer Enablement Plan with a one-billion-dollar budget – registered developers grew from 2,000 to 25,000+ in one year, with 230+ new solutions and 800+ new applications.Actively cultivating consumer cloud service ecosystem – in China, 220,000+ developers have registered for Huawei's consumer cloud, sharing CNY2.8 billion in revenue.

3.3 Assess Huawei's ecosystem strategy

Third, a firm's choice of ecosystem strategy -keystone, physical dominator, commodity or niche-is not only governed mainly by the feature and objective of the firm. But choice also can be affected by the business context in which it operates: the general level of turbulence and the complexity of its relationships with others in the ecosystem (Iansiti and Levien ,2004). Just as most firms follow niche strategy, it seems Huawei also takes the same approach initially by aggressively enhancing its specialized capability which is radically different with other firms. As the previous chapter discussed, nearly half of Huawei's employees are engaged in R&D and its continuously customers focused innovation activities symbolize its high level of value creation and innovation. Since the strategy framework is not fixed, it can be also argued that Huawei may be keystone in one domain and niche in another domain due to its business areas or Huawei may transform into keystone eventually with the respective to its rapid development recent years.

According to the criteria of assessing business ecosystem's health as previous chapter discussed, productivity, robustness and niche creation are 3 elements assess firm's health in business ecosystem. Respectively, the measurement for productivity is the return on invested capital index. The measurement for robustness is ecosystem member the firm has associated with and the measurement for niche creation is based on value creation or technological innovation. It seems Huawei has achieved the productivity, robustness and niche creation due to its Return on the invested capital index 21,6 %, which suggests its productive capability. In addition, the multifaceted dynamic players it has associated with in business ecosystem suggests its robustness and furthermore the highly technological involved innovation and R&D investment implies its niche creation. Thus, Huawei has achieved the healthy and dynamic development in business ecosystem.

3.4 Evaluate Huawei's open innovation mode and strategy

Let us now consider the fourth step to evaluate Huawei's open innovation mode and discuss its strategy. Based on data collected from white papers and Huawei's official website, it seems that Huawei selected modes 2 and 4: open innovation partnership and community approaches. According to Bagherzadeh, et al. (2015), open innovation partnership is required when firm engage in a more open and interactive process of solving an innovation problem and open innovation community

strategy means collaborative efforts from various individuals and organization with shared goals and value.

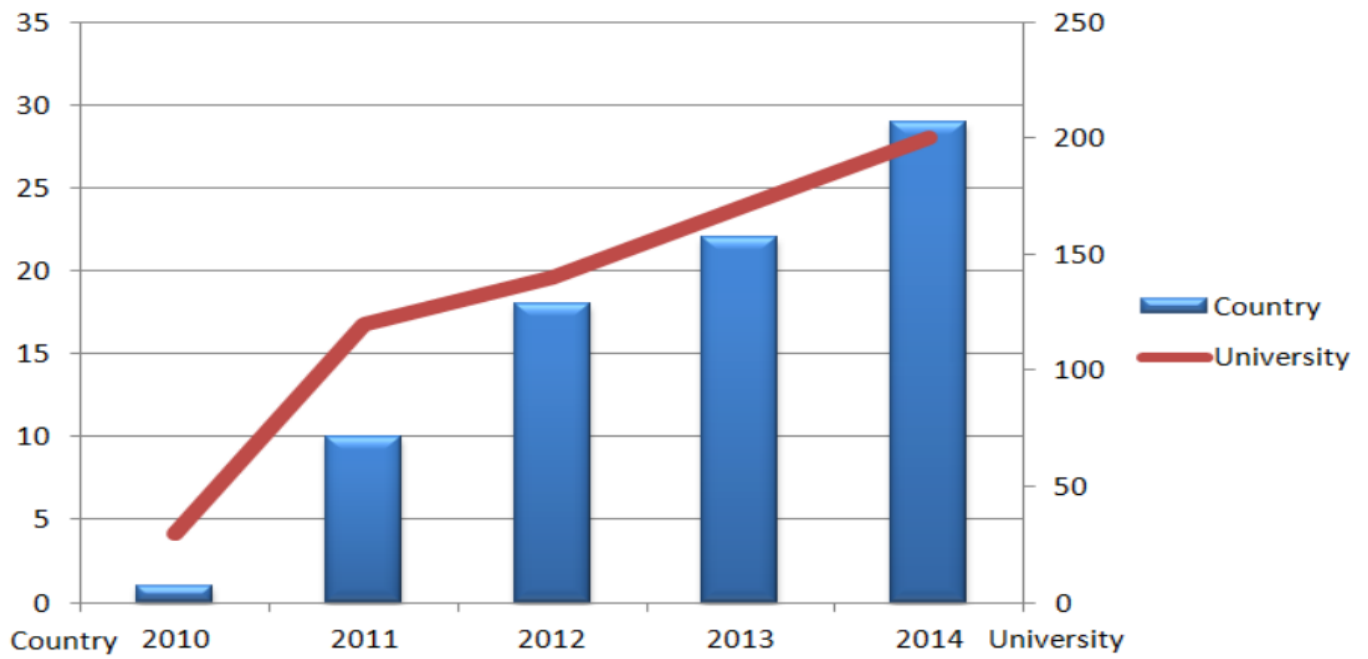
Huawei's open innovation partnership includes strategic alliances in various regions among industrial non-competitors, strategic partnership among competitors, joint venture program and such as collaborating with mobile service operators, manufacturers, equipment supplier, domestic and international universities and research institutions, local industrial communities and public-private partnership among host governments globally. In addition, Huawei's partnership is highly customer focused and there are intensive knowledge creating, sharing and learning expertise among various partners and communities.

First, at industrial level, firms in developing countries benefit in several ways from establishing strategic alliances with partners in advanced countries (Hobday, 1995). As Zhang stated (2013), by being partners of foreign companies in developing countries, domestic firms become a node in the global networks of these foreign firms. Huawei launched its R&D since 1992, until nowadays, it has established 34 R&D centers covering the regions not only in China, but also India, Sweden, United States, UK, Germany, France, Finland, etc. Besides, its partners include various leading European telecom operators such as Vodafone, Deutsche Telekom, BT, Accenture, Orange. Its joint venture center partners include Motorola, Siemens, IBM, Intel, Qualcomm, SAP, and Microsoft and so on (Hensmans,2017) .According to Huawei's annual report in 2016, it now has 13 Open Labs around the world collaborating with more than 400 partners to rapidly commercialize industry-specific solutions (www.huawei.com) .Thus, this kind of strategy has accelerated its access to foreign market, technology learning and reducing the R&D cost.

Second, at intra-academia collaboration level, Huawei launched Huawei University program collaborating with Chinese universities in 2005, which provided Huawei talented human capital and accelerated the knowledge creating, sharing and boosted Chinese endogenous ICT industry development. In the recent year, Huawei has embarked Huawei Innovation Research Program with expanding collaborating universities globally which corresponding to its globalization strategy as well. Since 2010, Huawei Innovation Research Program has developed rapidly, with initially the top 30 Chinese universities to almost 200 world renowned universities in 29 countries as the figure 11 shows. The collaborating universities include University of Cambridge, University of Oxford, MIT, Stanford and so on, representing an almost exponential rise in complexity (www.ispim-innovation.com).The diverse and international academia partnership also suggests Huawei's progress

in globalization which has assisted Huawei in accessing market resource and state to art technology, attracting talents, promoting technology development and facilitating knowledge learning.

Figure 11. Open innovation collaborations among academia globally (Huawei,2016)



Third, at the public infrastructure project level, Huawei’s open innovation approach has also closely associated with the local governments, industry field where it seeks aggressively global business opportunities since 2000. A likely explanation is that Huawei’s success can’t leave alone without Chinese governments supports. It is believed that Chinese policymakers has assisted Chinese firms move up the industrial value chain, international expansion of Chinese firms “go global” via considerable investments and supports (Ahrens,2013).

In the global scale, Huawei made the breakthrough in Europe in 2005, when it was selected as preferred Europe network supplier by British Telecom and Vodafone, which laid foundation for its further globalization. In addition, for example, Huawei cooperated with Ericsson and Nokia and 40 other Finnish organization partners in 5G test network project in Finland .Since 2015, as reward winner of the biggest contributor for 5 G development, Huawei has played major role in participating the European 3,5 billion 5 G public private partnership project which is milestone in innovative joint plan between the European Union and the European ICT industry in creating new markets such as smart cities, e-health, intelligent transport, education or entertainment & media (<https://5g->

ppp.eu/the-5g-ppp-has-started/). Not only in the developed areas, but also in developing regions such as Africa, South America and Asia, Huawei has launched various public infrastructures projects in expanding its market shares, promoting the local technology development, knowledge sharing and boosting the local economy efficiency.

3.5 Explore Huawei's knowledge management

The fifth step is to assess Huawei's knowledge management. Huawei is highly customer focused and there are intensive knowledge creating, sharing and learning expertise among various partners and communities. Since knowledge management is one of the key factor in open innovation and the creation and implementation of knowledge must be integrated with players in the business ecosystem so that it can benefit the value chain, Huawei's knowledge management such as intellectual property protection & licensing, patent application & protection and knowledge sharing system, etc. has played essential roles in the open innovation partner and community modes.

First, intellectual property is one of the critical factor of knowledge management in the open innovation ecosystem. Chesbrough (2003) pointed out, open innovation firms regard intellectual property is integrated part of technology strategy and insist managing it strategically. Technology licensee can integrate part of the licensor's knowledge into its own knowledge base, which provides the potential to achieve economies of scale and scope in innovation, and results in a larger knowledge base (Fleming, 2001; Lin, 2003). As Wang, et al., (2012) stated, licensee may increase its R&D efforts or other activities aimed at absorbing and developing the licensed-in technology which improve the output of open innovation.

Huawei values and absorbs the external knowledge and technology via foreign technology licensing agreement. For example, it has renewed the cross license agreement with other giant peers as Nokia, Ericsson and Qualcomm. Recently year, report from Guangdong provincial intellectual property office that monitors patents shows that Huawei licensed nearly 770 patents covering GSM, UMTS and LTE wireless communications technologies to Apple last year, while Apple licensed 98 patents to Huawei (China Intellectual Property Right Net,2016). In 2010, Huawei paid US 222 million in patent royalties to western partners and US 300 million in 2013(Tao, et al.,2016). As Chinese firm who had ever invested biggest amount in patent fee, Huawei has also benefited itself and therefore mitigated the intellectual property risks and demonstrated its commitment in protecting intellectual property and promoting knowledge sharing in the healthy open innovation ecosystem.

Second, Huawei has managed strategically about patent. According to the World Intellectual Property Organization, Huawei was ranked the No.1 patent applicant with 3898 applications globally and it has obtained 50,377 patents in total. Figure 12 indicates firms with most patent applications -globally patent battle recent years.

Third, Huawei embraces the open innovation culture and has put considerable efforts in building sufficient knowledge management team through web 2.0, social platform, open projects, knowledge sharing platforms, web offices and so on internally and externally. (Mitkova and Wang,2016). Since 2013, Huawei has aggressively promoted its knowledge sharing system with external players in the ecosystem via various social networking platforms. Additionally, it has innovative leadership management by its rotating CEO system and value talented human capitals. Through years Huawei has also established effective knowledge sharing system internally and externally as table 5 indicates. The Chronological development of Huawei’s knowledge sharing system illustrates the collaborations with various stakeholders.

Table 5. Development of Huawei’s knowledge sharing system (Mitkova and Wang ,2016)

<p>Simple knowledge management (up to 2008)</p>	<ul style="list-style-type: none"> • Isolated knowledge and IT system • Lacking of knowledge management specialists • Lotus note office platform and knowledge base
<p>Infancy stage(2008-2010)</p>	<ul style="list-style-type: none"> • Web 2.0 • E-learning • Developing Social platforms, Knowledge sharing communities • Establishing Knowledge management teams

Development stage (2011-2012)	<ul style="list-style-type: none"> • Strengthening knowledge management teams' awareness • Consolidating and constructing more knowledge sharing platforms and teams • Web office environment • Exploration of external players
Deepening stage (since 2013)	<ul style="list-style-type: none"> • Promoting knowledge sharing with wider business in new areas • More intelligent knowledge push • Strengthening social networks • Integrated knowledge management platforms

As discussed above, knowledge management has provided Huawei great opportunities where the complicated issues can be solved with coordinated efforts together and continuously meet customers' needs. This kind of intensive involvement and cooperation have assisted Huawei setting up rules for protecting of intellectual property and creating, sharing knowledge, promoting technology development and enhancing its competitive advantages and therefore achieved the catch-up transformation.

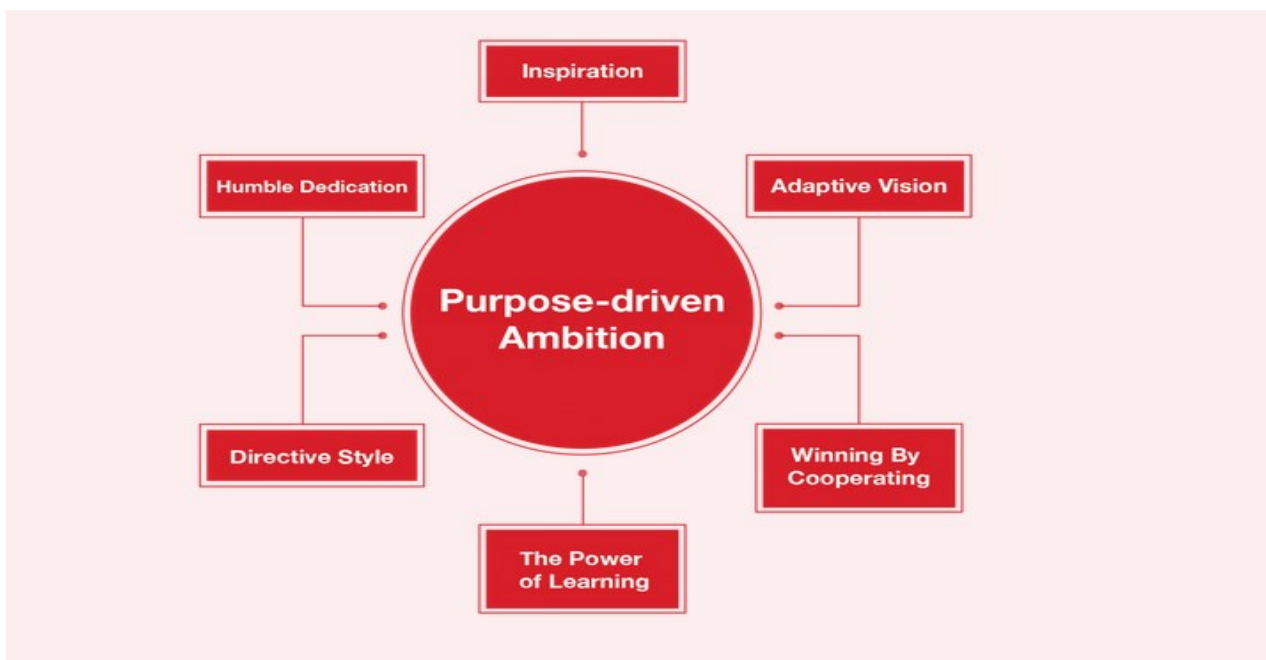
However, these findings do not rule out the influences of other certain challenges as how to establish the mutual interest and shared value and consequently build trust and collaborations, uncertainties and risks might associate with the inappropriate networking, different expectations, cultural variations and some security concerns.

3.6 Discuss Huawei's innovative leadership briefly

At last, successful leadership is another key component which spurs the innovation. Due to the scope of this study, I will discuss this part briefly. It is well believed that effective leadership is the safeguard of the healthy and efficient organization. As Nelson and Quick (2014) stressed that effective

leadership act as enablers of changes to organizations and is the key to influencing organizational behavior and achieving organizational efficiency. Additionally, Tao and Cremer (2015) identified 7 important elements of Huawei's effective leadership through numerous years' researches as the figure 12 indicates. It seems the kernel of Huawei's leadership is based on the purpose-driven ambition, which can be interpreted as the mission and value of the Huawei. Second, the founder of Huawei, Ren Zhengfei works hard to translate the purpose of the company into a vision aimed at Huawei achieving a world leading status by designing strategies to adapt his vision to the challenges that the company faces (Tao and Cremer ,2015). Third, the inspiring leadership of its top management has greatly motivated employees. Likewise, the humble dedication, directive style and winning by cooperating suggest the importance of shared responsibility as well as the collective efforts. Moreover, the power of learning indicates the commitments of Huawei in creating knowledge based environment and company culture which drive the innovation of the firm.

Figure 12. The 7 leadership lessons of Huawei (Tian and Cremer ,2015)



4. Challenges and risks in globalization

According to Huawei's annual reports from recently years, although it has achieved some significant success in Chinese market, EMEA and Asia pacific markets, it seems Huawei's inroad towards United States is still relatively difficult. Despite Huawei has established collaborations with various

influential US partners as IBM, Microsoft, open innovation research cooperation with renowned academia such as Harvard, MIT, Stanford, UC Berkeley, it's still questionable about its process in US regions due to the network security reason. At some point, this observation suggests the barriers in US and other western countries may negatively impact Huawei's global market progress.

Second, it's commonly assumed that globalization provides firm more opportunities, but by contrasts, it may incur risks and challenges. It seems the concept of globalization needs guarded attentions. This is evident as China has joined the WTO since 2001. The participation with broader scope of multinational organizations has provided china more opportunities in open innovation and expanding global market as well. However, WTO's membership also implies the firms must comply with the rules and regulation as stipulated.

It is believed that multiple Chinese firms have benefited from Chinese government's ambition in promoting indigenous firms progress in globalization, in addition, aiming at promoting innovations, Chinese government has put remarkable efforts in reforming R&D, investing market orientation innovation, protecting intellectual property and regulating the legal & policy environment (World Economic Forum ,2016). However, Huawei's close tie with Chinese government raises up the security concern and therefore casts the doubts about its transparency. Many western firms have complained about the Chinese government's subsidies may constitute the unfair trade practice or violate the WTO rules (Karam,2016). As Ahrens stressed (2013), Huawei's ongoing competitiveness may be greatly hindered by governance issues. According to Ahrens (2013), without a public listing to make its governance more fully transparent and the establishment of better global standards for delineating the national security boundaries of information security, Huawei will likely continue to struggle in the United States, Australia, and some European countries. Thus, Huawei must improve the transparency of its business and meet the publics expectations in the ICT ecosystem.

Third, compared to its main peers as Samsung and Apple and other Tech Giants from developed countries, Huawei is just catching-up firm which has relatively less brand visibility and comparatively less capability in competitiveness. Therefore, it can be argued that unless buoyed by strong internal R&D aptitude, Huawei is somewhat insufficient to compete with the holistic ability in strategic control over R&D, production, marketing, and collaboration of the entire commodity chain (Liu and Cheng,2014). One possible implication of this is that it may take a long time for Chinese catch-up firms as Huawei to develop and possess the holistic capability in global ICT filed.

5.Key findings and implications

First, one interesting finding is that firm shall take a holistic perspective if it wishes to enable the effective open innovation in business ecosystem. Based on the studies regarding to open innovation and business ecosystem, the framework which I summarized could be used as a strategic approach. There are interactive and synergistic relationships among those 6 elements in the framework which boost the effective open innovation. Thus, accordingly, firm shall evaluate the its business ecosystem stage and identify the relevant players. Moreover, it's crucial to implement the strategy corresponding to the business environment and choose and manage the open innovation mode tactically. Specifically, knowledge management and innovative leadership are also key components for success.

Second, it is interesting to note that Huawei's open innovation strategy is based on broad context of business ecosystem, which is the key for its success. The evidence of this report suggests although internal engagement in R&D is crucial, external engagement and commitments with relevant business ecosystem actors are also indispensable. As discussed previously, there are evidences to suggest that positively enlarging progress of open innovation from initially limited indigenous scale to gradually expanded to global scale which involves diverse ecosystem actors. Those observations also indicate Huawei's open innovation are multifaceted which includes joint ventures, strategical alliances, partnership, community and so on. Moreover, it can be inferred that Huawei's knowledge management and innovative leadership have also played essential role in promoting its effective, value added open innovation ecosystem.

Third, this research provides some supports for the conceptual premise that benefits of open innovation in reducing cost and risks, adding more value in the commodity chain, creating more market opportunities, creating and sharing knowledge and enhancing its competitive advantage etc. Therefore, it can be assumed that for catch-up firm, it's strategic to adopt the open innovation if it wishes to enhance the competitive advantage. Nevertheless, this finding has important implication for firms from developing countries, its impractical to imitate the western paths. In essence, It's crucial to develop its own path according to its particular situation and align with the national goal strategically. What is surprising is that this research also suggests Huawei benefits significantly from Chinese government's ambition in developing and promoting its national ICT industry in global scale. This raises the intriguing question regarding to the nature and extent of the relationship between government and business. The evidences from this study also implies the importance of establishing

cooperative long term relationship with government and indigenous policy makers where firm wishes to expand its business.

In addition, although Huawei is an excellent catching-up case which was based on open innovation ecosystem strategy, on the other hand, yet due to the scope of my study, this report is unable to demonstrate whether there are plenty Chinese firms which have possessed truly innovative competence in the global scale. Therefore, it seems to be a definite need for not only Chinese firms as Huawei, but also Chinese policy makers be aware of the severe challenges such as China's some core technology still lag behind compared to more developed countries who have long histories of innovation (world economic forum, 2016). Likewise, as Liu and Cheng (2014) suggested, for china to become truly innovative county, it needs to give market space to incubate and eventually yield radical innovation. Hence, Chinese government and policy makers shall regulate more transparent, open polices which promote effective open innovation in healthy business ecosystem. Taken together, those results suggest that its strategic for catching-up firm to adopt the open innovation in business ecosystem if it wishes to enhance its competitive advantage and compete in global market.

6. Bibliography

Ahrens, N. (2013). *China's competitiveness: Myth, reality, and lessons for the United States and Japan, case study: Huawei*. CSIS Working Papers. Available from <http://csis.org/program/chinas-competitiveness>.

Brant, J. and Lohse, S. The Open Innovation Model (April 11, 2014). ICC (International Chamber of Commerce) Innovation and Intellectual Property Research Paper No. 2. Available at SSRN: <https://ssrn.com/abstract=2426097>

Brunswick, S., Bagherzadeh, M., Lamb, A., Narsalay, R., Jing, Y. (2016). *Managing open innovation projects with impact. Whitepaper Series*. Research Center for Open Digital Innovation, Purdue University. West Lafayette, Indiana.

Burkitt-Gray, A. (2016) Samsung and Huawei lead innovation top 10. Global Telecoms Business. Available from: <https://www.globaltelecomsbusiness.com/article/b11vy6q4gxtprx/samsung-and-huawei-lead-innovation-top-10> [Accessed on May 18, 2016].

Chesbrough, H. W.(2003) *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Boston: Harvard Business School Press.

Chesbrough, H.W. (2003) The Era of Open Innovation. *MIT Sloan Management Review*, Vol. 44, 3, p. 35-41 Available from: <http://sloanreview.mit.edu/article/the-era-of-open-innovation/> [Accessed on 15 April 2004].

Chesbrough, H. (2007). *Why companies should have open business models*. MIT Sloan Management Review, 48, 22–28. Collaboration shapes innovation: Development, Vol. 23, No. 7, pp.1171–1193.

China Intellectual Property Right Net. (2016, November) Apple faces major 'roadblocks' after losing trademark battle. Available from: http://english.cnipr.com/news/corporation/201605/t20160511_196817.html

Diga, K.& May, j. (2016) 'The ICT Ecosystem: The Application, Usefulness, and Future of an Evolving Concept.' *Taylor Francis Online*[Online].

Available from :<http://www.tandfonline.com/doi/full/10.1080/02681102.2016.1168218> [Accessed on 05 Sep 2016].

Fact Sheet, *Intellectual property management in open innovation. (2015)* Available from: <https://www.iprhelpdesk.eu/sites/default/files/newsdocuments/Fact-Sheet-IP-Management-in-Open-Innovation.pdf> [Accessed on December 2014]

Finland: Tekes (2015) *China's Innovations Are Going Global –New Emerging Business Models*. Helsinki: Tekes –the Finnish Funding Agency for Innovation.

Fleming, L. 2001. Recombinant uncertainty in technological search. *Management Science* 47 (1): Vol. 47, No. 1, 2001, pp. 117-132. doi:10.1287/mnsc.47.1.117.10671

Hensmans, M. (2017), *Competing Through Joint Innovation*, MIT Sloan Management Review, Winter 2017, Available from: <http://sloanreview.mit.edu/article/competing-through-joint-innovation/>

Hobday, M. (1995), 'East Asian latecomer firms: learning the technology of electronics', *World Development*, 23(7), pp.1 171-93

Huawei Innovation Research Program (HIRP), available from: ispim.org/wp-content/uploads/GP_Submission_Huawei.pdf [Accessed on 2015].

Iansiti, M. and Levien, R. (2004) *Strategy as ecology*. *Harvard Business Review* 82:68–81. Available from: <https://hbr.org/2004/03/strategy-as-ecology> [Accessed on March 2004].

Johnson, J. (2004) *Strategies matched to business environment*. Available from: <http://maaw.info/ArticleSummaries/ArtSumIansitiLevien04.htm> [Accessed on Fall 2004].

Kelly, E. (2015) “Introduction: business ecosystems come of age”, *Business Ecosystems Come of Age*, Deloitte University Press, pp. 3-15

Karam, A. (2016) *The China Factor: Leveraging Emerging Business Strategies to Compete, Grow, and Win in the New Global Economy*. John Wiley & Sons.

Li, Y.R. (2009) The technological roadmap of Cisco's business ecosystem. Science Direct. Available from:<https://www.deepdyve.com/lp/elsevier/the-technological-roadmap-of-cisco-s-business-ecosystem-GeWsZHDKMY> [Accessed on May 2009]

Liu, Q. (2015) Corporate China 2.0: The Great Shakeup . Palgrave Macmillan US.

Liu, X.L., Cheng , P. (2014) National Strategy of Indigenous Innovation and its Implication to China, Asian Journal of Innovation and Policy. Available from :
http://society.kisti.re.kr/sv/SV_svpsbs03V.do?method=download&cn1=JAKO201424750260477.
[Accessed on May 2014].

Moore, J.F. “Predators and prey: A new ecology of competition,” *Harvard Business Review*, May 1993, Available from: <https://hbr.org/1993/05/predators-and-prey-a-new-ecology-of-competition/ar/1>, [Accessed on March 17, 2015].

Nelson, D. and Quick, J. (2014). *Organizational Behavior*. 4rd ed. Canada: Cengage Learning,

Porter, M.E. (1991) The Competitive Advantage of Nations. *Harvard Business Review* ,Available from: <https://hbr.org/1990/03/the-competitive-advantage-of-nations> [Accessed 1990].

Tao, T., Cremer, D.D., , Wu ,C.B, (2016) The Huawei Story, SAGE Publications India, 11 Oct 2016 - Business & Economics.

Tao, T. and Cremer, D.D.(2015) Leading Huawei: seven leadership lessons of Ren Zhengfei. All China Reviews. Available from: <http://www.allchinareview.com/leading-huawei-seven-leadership-lessons-of-ren-zhengfei/>

Teece, D., Pisano, G., & Shuen, A. 1997. Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, 18(7):509–533.Available from:
[https://www.business.illinois.edu/josephm/BA545_Fall%202015/Teece,%20Pisano%20and%20Shuen%20\(1997\).pdf](https://www.business.illinois.edu/josephm/BA545_Fall%202015/Teece,%20Pisano%20and%20Shuen%20(1997).pdf)

Europe launches a 3.5 Billion investments in 5G. (2015) Available from: <https://5g-ppp.eu/the-5g-ppp-has-started/>

Wang, Y., Vanhaverbeke, W., Roijackers, N., Chen, J., (2011) How Chinese Firms Employ Open Innovation to Accelerate the Development of Their Technological Capability. Available from: <https://pdfs.semanticscholar.org/57d6/b090f665974824fc2cbd02f73248b436662b.pdf>

Wang, X., Mitkova, L. (2016) Knowledge Sharing System Under Open Project Perspective: Chinese Experience, Knowledge and Project Management, Volume 5 of the series Knowledge Management and Organizational Learning pp 181-194, Springer International Publishing.

Woetzel, J., Orr, G., Lau, A., Chen, Y., Chang, E., Seong, J., Chui, M., Qiu, A. (2014). China's digital transformation: The Internet's impact on productivity and growth. [online] McKinsey Global Institute. Available from: www.mckinsey.com/.../industries/.../chinas%20digital%20transformation/mgi%20china [Accessed on June 2016].

World Economic Forum. (2016). CEO Policy Recommendations for Emerging Economy Nations China. Available from <http://reports.weforum.org/manufacturing-growth/china/>

Zhang, K.H. (2013) How does foreign direct investment affect industrial competitiveness? Evidence from China. China Economic Review (2013) Available from: <https://pdfs.semanticscholar.org/0ea7/4de797341beee5a9ab3d4cea8395b5c645e0.pdf> [Accessed on 28 August 2013].

Zhang, Y. (2009) Alliance-based network view on Chinese firms' catching-up: case study of Huawei technologies co. ltd. UNU-MERIT working paper. 2009-039.

Ziegler, C. (2011) *Nokia CEO Stephen Elop rallies troops in brutally honest 'burning platform' memo? (update: it's real!)* Available from: <https://www.engadget.com/2011/02/08/nokia-ceo-stephen-elop-rallies-troops-in-brutally-honest-burnin/> [accessed on August 2011].