

The Ideal Path to Technological Ascent of Developing Firms in China – Interactions between Institutions, Firm Characteristics and Technological Strategies

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List of Abbreviations

ACFTU:	All-China Federation of Trade Unions
CCP:	Chinese Communist Party
CNR:	China Northern Railway
CRRC:	China Railway Rolling Stock Corporation
CSR:	China Southern Railway
ESOP:	Employee Stock Ownership Plan, Huawei specific term
FFF:	Foreign frontier firm
GE:	General Electric
GSM:	Global System for Mobile Communications
IBM:	International Business Machines
ICT:	Information and Communications Technology
IPR:	Intellectual Property Rights
ITC	Software Solutions: The Irvine Technology Corporation Group
JV:	Joint venture
LCF:	Late-comer firm
LLC:	Limited Liability Company
M&A:	Merger and acquisition
MaSo:	Majority state-owned enterprise
MiSo:	Minority state-owned enterprises
MOR:	Ministry of Railways (of China)
MPT:	Ministry of Post and Telecommunications
NGO:	Non-Governmental Organisation
NVH:	Noise, vibration and hardness components
OECD:	Organisation for Economic Co-operation and Development
PBX:	Private Branch Exchange Switch
PLA:	People's Liberation Army
POE:	Private-owned enterprise
R&D:	Research & Development
ROI:	Return on Investment
SAIC:	Shanghai Automotive Industry Corporation
SDH:	Synchronous Digital Hierarchy
SEZ:	China as a Special Economic Zone
SIPO:	State Intellectual Property Office of China
SOE:	State-owned enterprise
TMT:	Zhuzhou Times New Material Technology
WTO:	World Trade Organisation
ZF Sachs:	Zahnradfabrik Friedrichshafen, German manufacturer
ZTE:	Zhong Xing Telecommunication

Abstract: The Ideal Path to Technological Ascent of Developing Firms in China – Interactions between Institutions, Firm Characteristics and Technological Strategies

Innovation in China is a topic plagued by misconceptions. The Chinese laissez-faire approach on intellectual property rights protection in the early years of the country's technological development, has led to the continued misconception of technological abilities in Chinese developing firms. This research takes Whitley's institutional framework of 1999 and the technology strategies literature as a starting point for further analysis. There are gaps in the literature as to the links between national institutions, firm characteristics, and technological strategic choices of Chinese firms. This doctoral research develops all of the above into a coherent framework.

The thesis draws on a paired case study approach of two technologically successful Chinese domestic firms. Each of these two reflects a different ownership model, as well as a different industry and geographical position in China. The study is designed as an abductive research using a qualitative approach. A total of 44 semi-structured interviews were conducted, with both managers and employees of the two case study firms and with external industry and government experts. This wider external perspective on the technology path of developing Chinese firms has been previously missing in the discussion of technology strategies for latecomer firms in large developing economies. The overall aim of this study is to isolate an ideal path of technological ascent of developing firms in China and to gain a deepened understanding of how the national institutions and firm characteristics support it.

The findings reveal that the most probable path to technological ascent for Chinese developing firms starts with an imitative technology strategy, maturing into a defensive one as the firm progresses on the path. This confirms previous studies on the technological development of Chinese firms. Further, the study finds that external sufficient conditions are created by the national institutions, while necessary internal conditions are rooted within firm characteristics. To understand the diversity across China, it was necessary to analyse the nature of institution-firm interactions within the context of the newly developed four dimensions: size, ownership, industry, and location. This revealed that there are great differences in a given firm's range of choices for their technological strategy and resulting probability for technological ascent, depending on their position in the four-dimensional matrix.

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1. Introduction

1.1 Background to the Thesis

The role of the national institutions in creating a unique national economic environment is well established in the academic literature (Hall & Soskice, 2001; Campbell & Pedersen, 2007; Whitley, 2007). The four key features of national institutions explored in this research are the (i) state, (ii) financial system, (iii) skill development system, and (iv) authority and trust system. This thesis explores how Chinese national institutions affect developing domestic firms in general, and in particular their choices in technological strategies. Institutional literature states four key features of national institutions are important for this development, because their different national configurations lead to different sets of boundaries in which firm characteristics can be developed by domestic firms. Within the scope of this research, domestic firms are defined as firms that have been founded and undergone initial phases of development in their respective country. For instance, Munich founded BMW would be understood as German, while Taizhou founded Geely (吉利汽车 - Jílì Qìchē) based on this definition would be Chinese. This definition is grounded within the underlying logic of this research: domestic firms are influenced by their national institutional context, which is reflected in the firms' key characteristics.

National Institutions

The national institutional features are setting the framework and preconditions under which the national economy operates. The most significant institutional features are: (i) the state, (ii) the financial system, (iii) the skill development system, and (iv) the authority and trust structures. Based on those four institutional features it is possible to determine a set of key firm characteristics that strongly influence not only the competition model of the firm, but also the chosen technology strategy. The state influences through its policies and regulations the national institutional context, such as the financial system, labour market, and the education system. These in turn influence firm features in terms of such elements as: inter-firm relations, corporate governance, growth models, and strategic priorities. In a third and final step, the organisational characteristics of firms are guided and shaped by the above stated firm features and as such indirectly through the set-up of national key institutions.

The national institutions in China fulfil the same functions as they do in any other nation state as they create the institutional context in which firms can operate and develop. The institutional set up is however unique in the case of China with the role of the state being more emphasised due to its historical heritage as centrally planned economy. Rooted in this historical heritage is the extensive presence of the state in different forms within the Chinese economy. In the past Chinese institutions have been often criticised from Western scholars and politician for being unreliable and inconsistent, a fact which has significantly changed after the 2001 World Trade Organisation (WTO) accession and the subsequent economic development to follow. And yet, though the levels of institutionalisation have become more consistent on paper their effect on firms still varies strongly depending on the firms: size, ownership type, geographic location, and sector they are operating in.

Key Characteristics of Firms

Key characteristics of firms can broadly be differentiated into firm characteristics and organizational capabilities. Firm characteristics are the features that expand on the influence of owners, managers, employees, and business partners in the decision process to determine the firms' main objectives and the resulting behavioural consequences. The organizational capabilities and strategies can be used to further subdivide firms as their approach on capability development and utilization differs according to their overall strategic focus on either innovation or responsiveness. While the institutional features shape the national economy as a whole, the key characteristics of firms strongly influence the nature of the national firm. The two are closely related to each other as the national institutions set the boundaries in which firms can utilize and develop key characteristics.

In a Chinese context the key characteristics of firms are shaped by the national institutions, however the key characteristics differ according to the level of impact that the intuitions have on the firm. Using the four dimensions of institutions a range of firms can be developed to capture the varied institutional impact onto Chinese firms. Firms are differentiated according to their access to state controlled resources, ranging from majorly disadvantaged to majorly advantaged firms. The positioning of the firms on the range is dependent on the levels of state attention the firms are subject to. These different levels of attention impact the individual institutional context for each

firm and therefore impact the firms' key characteristics and subsequently their strategic and technological choices.

Technology Strategies

Firms operating in developing economies will eventually find themselves in a position where they need to consider different choices to improve their technological capabilities to catch up with the established firms in the international market. The needed technology usually sits with the 'foreign frontier firms' (FFF) in established economies, hence it being key for the 'late-comer firm' (LCF) to gain access to this technology to improve its own capability on which it will be able to develop own technologies later on. Foreign frontier firms are understood as firms leading in their industry in terms of product technology and production efficiency. LCF are defined as a late entrant to an industry, initially lacking technology and market access, with its main focus on technological catch-up, and very few competitive advantages besides low costs (Matthews, 2002). Key issue is the manner of the transfer and its timing within the development time line of the LCF. It is considered best practice for LCFs to initially focus on obtaining production capabilities in form of licensing or joint-ventures, and at a later stage shift efforts towards building independent technological capabilities (Xia et al., 2002). Core to the technological catch-up are the development of the LCF's technological capabilities (TCs). Technological capabilities are understood as the ability to use technological knowledge efficiently to assimilate, use, adapt, and change existing technologies. This, in theory should, ultimately allow the late-comer firm to create new technologies resulting in new products and processes (Xiao et al., 2013). The research will draw on Freemans' (1992) differentiation along the lines of imitative and dependent technology strategies and their associated requirements in respect to firm governance structures and key capabilities.

As stated in the above theoretical elaboration, firms in China are basically faced with decision to either choose an imitative or dependent technology strategy. Dependent technology strategies and their fast results in upgrading technology levels and product quality have been highly popular in China. These however are critically depending on the access to finance, markets, and foreign technology. This particular technology strategy is only of interest to firms that benefit from major advantages in access to these state controlled resources. Imitative strategies provide a more long-term

potential for learning as technology obtained needs to be unbundled. It however takes significantly longer to improve technology levels and product quality as opposed to the dependent technology strategy. It however poses less demanding requirements in regards to resource access making this an attractive choice for disadvantaged firms.

Two case studies were conducted to investigate the outlined research objectives. The research analyses two cases of technologically successful outlier firms and their path of development. For the sake of clarity the different usage of terminology for disadvantaged and outlier firms will be briefly outlined for this study. Within this research disadvantaged firms are being understood as Chinese domestic firms that are having limited or less preferential access to key resources such as finance, labour, or markets. Outlier firms are domestic Chinese firms that despite their disadvantaged starting point in development managed to become technologically successful. As the term 'outlier' indicated these type of firms are the exemption rather than the rule. Case One, state-owned Zhuzhou Times New Material Technology Co. Ltd. (株洲时代新材料科技股份有限公司 - Zhūzhōu Shídài Xīn Cáiliào Kējì Gǔfèn Yǒuxiàn Gōngsī) is operating in a medium-high technology sector as a producer for railway components. The studied firm falls into the category of a small/medium sized state-owned enterprise based in a remote geographic location operating in a strategic industry sector. It can be considered a Chinese outlier firm as it is technologically successful, however based on their external conditions, it should be disadvantaged with regards to its development. For instance, the firm is based in a remote location with limited access to finance, skilled labour, foreign technology, and markets and being small in size of limited interest to the Chinese state, hence limited levels of state support are provided. Case Two, Huawei Technologies Co. Ltd. (华为技术有限公司 - Huáwéi Jìshù Yǒuxiàn Gōngsī) is a privately founded firm operation in the telecommunication equipment manufacturing sector. This is categorised as a large sized private-owned enterprise based in a central coastal geographic position operating in a strategic industry. The case falls in the category of a Chinese outlier firm, because in strategic sectors, privately owned firms are significantly disadvantaged. The Chinese state strongly supports state-owned enterprises in strategic sectors for the sake of better control over these industries of crucial importance to national interest. Furthermore, with the case study firm located in a more affluent coastal area, the levels of

international and domestic competition, as well as state presence, are much higher causing more pressures placed onto the firm. Yet, the firm managed to overcome these obstacles and become technological successful, making it ideally suited for the intended purpose of this research.

The similarities between the two firms, is that they are outlier firms within the Chinese institutional context that have been equally successful in the Chinese domestic and foreign market, meaning that they can be considered as leading firms in their field. This makes both cases suitable to explore, because they both managed to overcome a disadvantaged starting point within the constitutional context and become technologically successful. It is of interest to this thesis to understand the how these firms have been affected in terms of their technological development by the national institutions, and how this has impacted their choices in the technology strategies selected. Understanding the internal and external factors impacting the choices of these firms, will allow gaining a dynamic insight into the technological development of successful Chinese firms.

1.2 The Research Questions

This thesis seeks to assess the technological strategy choices of domestic Chinese firms and their path to technological ascent, by answering the following research questions:

1. What is the optimal path to superior organisational capabilities for Chinese domestic Firms, and how have National Institutions shaped the firms path to technological ascent so far?
2. How did those Chinese domestic firms that succeed in developing superior organisational capabilities achieve it, and to what extent have the National Institutions supported this process?
3. Under what conditions, both external and internal, are Chinese domestic firms likely to develop superior organisational capabilities?

1.3 The Structure of the Thesis

Chapter two provides an academic background to the research's objectives, and outlines the five main theoretical pillars that help explain the technological development of firms. These are national institutions, key characteristics of firms, ideal

firm types, technology strategies, and competition models. This chapter demonstrates the close interconnection between national institutions, and their influence on key characteristics of firms building strongly on Whitley's (2007) work on the subject. This connection and line of influence, is further linked to technology strategies for latecomer firms in developing economies. The section suggests that these five threads of theory within institutional research lack integration. It is shown how the research presented in this thesis addressed this shortfall by merging the threads of national institutions, firm characteristics, and technology strategies. Further, in chapter three, the existing theoretical frameworks that have been developed around a predominantly Western perspective, will be integrated further in a Chinese context.

Chapter three reviews the general threads of the research from a Chinese perspective, and expands on the literature review in the context of developing economies. This is essential because the general concepts fall short in addressing the reality of China's fragmented and unique economic environment. There is a wide array of Chinese focused literature and research to be found, but often it is developed around a very narrow industry or firm focus and falls short of grasping the institutional wider picture. The presented research consolidates these and provides dynamic insights into the interaction between national institutions, firm characteristics, and the technological development of firms in China. Starting with a chapter overview, the structure of the section follows the overall logic of the previous theoretical chapter. The section is continued by an analysis of the key Chinese national institutional features: state, financial system, skill development system, and authority and trust system. It then sets the scene by reviewing the Chinese institutions and the national institutional context they create, in which firms can operate within. In the following subsection, to gain a better understanding of the development of Chinese firms they are analysed around, the impact of the four dimensions on corporate governance, finance, labour relations are explored. These four aspects of differentiation are (i) ownership, (ii) size, (iii) sector, (iv) and location. As elaborated on in the introduction, China's institutional context differs according to the above four dimensions, impacting the firms' key characteristics and subsequently, their choices in technological strategy and mode of competition. In subsection 3.5, the above stated analysis of the impact of the four dimensions on corporate governance, finance, and labour relations will be drawn

together and developed in an overview of different types of domestic Chinese firms, along those lines of differentiation. In the following parts of the chapter, the different types of domestic Chinese firms will be linked to the different technology strategies and modes of competition. The chapter concludes with a summary, bringing together the previous sections and linking the general and China specific strings of literature.

Chapter four outlines the general methodology underlying the empirical research conducted in case one and case two. This chapter addressed philosophical assumptions, ethical considerations, sample size, and the interview schedule used as guidance during all semi-structured interviews conducted. This Chapter acknowledges the unique challenges associated with doing research in a Chinese setting from the quality of empirical data collected, to cultural mannerisms impacting the research. This section also presents measurement instruments and specifics of the data collection procedures, the selection process of the sample, and language related complexities.

Chapter five demonstrates the empirical findings for both case one and case two. The section is twofold: the first section presented the research for case one, and the second one for case two. Case one focused on a medium-sized majority state-owned Chinese firm operating in a pillar industry, located in remote inland location. In comparison, case two as a large privately held Chinese firm operating in a pillar industry, is based in a more affluent coastal area of China. The two case study firm can be considered to be disadvantaged domestic Chinese firms, albeit for different reasons. The two case study firms have in common to represent disadvantaged domestic Chinese firms. Whilst case study one is disadvantaged due to its geographical location and ownership type in regards to innovation, case study two is disadvantaged in regards to its industry and ownership in regards to access to market and finance. Both cases follow the same overall analytical structure, starting with a presentation of industry background and corporate profile to set the scene. The empirical research is guided in its structure by the theoretical considerations above. The studies are differentiated along the aspects of ownership, size, sector, and location. Each case concludes with a brief summary of the discussed and preliminary results are being presented. The chapter is finalised by a comparison of both case studies, drawing together the similarities and difference across them. It also explores how case two complements the research conducted in case one.

Chapters six and seven present an overall discussion of the results from both cases one and two. The chapters integrate the findings from the two case studies, and link these with existing research. It highlights the main contributions of the research and discusses theoretical and practical implications. Limitations of the two studies are considered and suggestions for future research are then presented. Finally, the chapter closes with some core conclusions that can be drawn from the conducted research.

2. General Literature Review

2.1 Purpose of Chapter

The purpose of this chapter is to illustrate the different theoretical frameworks covering aspects of relevance to understand the ideal path for technological ascent of Chinese firms. A multi-layered approach can be helpful to grasp the complex linkage between the state, other national key institutions, and firm characteristics. As it has been previously mentioned, the review of relevant literature will be split between Chapter 2, which will look at the literature from a wider theoretical point, and Chapter 3 with a closer focus on the core aspects of literature in a Chinese context.

The chapter will look in detail at the literature on national key institutions, key characteristics of the firm, and choices in technology strategies available to developing firms. The first section will map out the background against which firms can develop within a domestic context. It is set up by the prevalent national institutions in place which will be covered in the below section 2.2 and is divided into the role of the state, the financial, skill development, as well as authority and trust system. Moving away from a macro level view of the nation and turning to a more micro level approach, the following section 2.3 will elaborate on the key characteristics of firms and their interdependencies with national institutions to understand the linkage between the role of domestic institutions, firm governance systems, and organisational capabilities. In a third step, section 2.4 will illustrate the different choices of technological strategies available to developing firms and their associated preconditions in respect to key firm characteristics. The final section 2.5 draws on the previous sections elaborated in this chapter and will link together the macro level analysis of state institutions, the micro level aspects of firm characteristics, and the different choices in technology strategies together to build an initial theoretical conceptualisation of the ideal path of technological ascent of the developing firm. The chapter will conclude with a summary of all previous sections drawing together the key aspects elaborated into an overview for further analysis.

The theoretical framework of national innovation systems revolves around understanding the interactions and connections among the actors involved in innovation as key to improving the technology performance of the nation and domestic firm. Innovation and technical progress are seen as a result of complex set of

relationship among actors producing, distributing, and applying various kinds of knowledge, such as private enterprises, universities, and public research institutes. According to the different streams of literature in national innovation systems (Table 1), the innovative performance of a country depends to a large extent on how different actors interact with each other as elements of a collective system of knowledge creation and what kind of technologies they have available to use (Freeman, 1987; Nelson, 1993; Chung, 2002; Lundvall, 2002; Jensen et al, 2007).

The linkages between different actors can take different forms such as joint research, personnel exchanges, cross-patenting, and purchase of equipment. There is a wide variety of definitions of national innovation systems within the main stream literature and while they differ one way or another in their viewpoint of the topic they do all emphasise the web of interactions amongst multiple different stakeholders. An overview of definitions can be found in the table below:

Table 1: National Innovations Systems - Definitions

National Innovation Systems - Definitions	
Freeman, 1987	"[...] the network of institutions in the public and private sectors, whose activities and interactions initiate, import, modify and diffuse new technologies."
Lundvall, 1992	"[...] the elements and relationships which interact in the production diffusion and use of new, and economically useful, knowledge [...] and are either located within or rooted inside the borders of a nation state."
Nelson, 1993	"[...] a set of institutions whose interactions determine the innovative performance of national firms."
Patel & Pavitt, 1994	"[...] the national institutions, their incentive structures and their competencies, that determine the rate and direction of technological learning (or the volume and composition of change generating activities) in a country."
Metcalfe, 1995	"[...] that set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store, and transfer the knowledge, skills and artefacts which define new technologies."

A challenge of the national innovation system literature is to capture the complex and multi-layered aspects of emerging economies with less established and coordinated institutional set ups especially in the fields of skill and labour markets.

Another stream of literature that puts great emphasis on the challenges for emerging markets is the one of Institutional Voids. Khanna and Palepu (2005) coined the term institutional void in order to help explain the national institutional environment that firms are dependent on, and the fact the institutions that make up this market ecosystem are either missing or not fully functioning in emerging countries. Their work closely focuses on the different aspects of national institutional systems, such as labour markets, product markets, and capital markets in general. While the literature stream of institutional voids is better suited to capture the overall economic situation in emerging economies, it falls short in the case of China to capture and credit the unique and highly influential role of the state in economic development and domestic firm development in particular.

Whitley's (1999; 2007) framework on national systems of institutions is best suited to not only capture the complexity of the interactions between national institutions and domestic firms but also how these in turn influence the firm's key characteristics which have impact on the technology strategy that is viable for the firm to pursue. For this research it is important to understand and establish this correlation to be able to develop the ideal path for technological development of Chinese developing firms.

Section 2.2 below will focus on the different key national institutions and their influence onto firm characteristics, while section 2.3 will shift the focus from away from the institutional level towards the one of the firm and how firm's characteristics interact and depend on the institutions.

2.2 National Institutions and their influence on Firm characteristics

The types of firms in a national market economy are a result of the national institutions. The national institutional features set the conditions for the national economy. The following chapter will outline this influence based on the most significant institutional features as identified by Whitley (2007): (i) the state, (ii) the financial system, (iii) the skill development system, and (iv) the authority and trust

structures. These four institutional features shape the firm's key characteristics that in turn influence the firm's path of technological development.

2.2.1 The State – Why is state important for firms technology strategy and capabilities?

The concept of state in this work is understood as the country's government and its resulting impact on the national economic environment. The state influences through its policies and regulations the national key institutions, such as the financial system, labour market, and the education system. These in turn influence firm characteristics in terms of such elements as: (i) inter-firm relations, (ii) corporate governance, (iii) strategic priorities and (iv) choice in technological strategy.

Looking at the *overall attitude of states* Whitley (2003) developed four distinct state types, namely: (i) Arm's Length, (ii) Dominant Developmental, (iii) Business Corporatist and (iv) Inclusive Corporatist. These four distinct types of state differ in the overall attitude they take towards the national economic environment. The attitude of states is defined by Whitley (2007) as the different institutionalisation of conceptions of power and authority that impinge upon relations of subordination elsewhere in market economies, particularly within firms (p.40). Within each national economy the state defines the boundaries in which firms can operate. Depending on how states execute their power and authority to enforce these boundaries, firms will interact with the national institutions, competitors, and the market as such. Whitley in his work isolated the above four distinct types of attitudes of states.

The interactions between state and firms differ based on the state's modus operandi within the national economy and as a result impacts the firm characteristics of the firm. The reliability of legal system and institutions is of importance due to their key role in quality of public governance. According to Moon and Bretschneider (1997) the quality of public governance is crucial to create and foster innovation. Can firms not rely on their consistency they will be less likely to engage in any long-term strategies but rather follow a more opportunistic approach on business to be able to adjust to the quickly changing institutional context (Pezeshkan et al, 2016). Further, states differ based on their institutional standardisation and extent of official state institutions influence on economic transactions and activities such as: interest group formation, employment relations, and skill development just to name a few which in turn affect

firm characteristics of firms (Cooke, 1997; Estevez-Abe, Iversen, & Soskice, 1999; Lundvall & Johnson, 2002; Chang, 2003; Malerba, 2005).

According to Malerba (2005), the state actively influences national systems on various levels, such as knowledge creation, property rights, financial institutions, and skills formation. Building on Malerba, availability and protection of property rights fosters innovation nationally as it allows firms to capture value from their activities generating innovation (Olavarrieta & Villena, 2014). It shows that state interference on property rights does impact the firms' attitude towards innovation and its value generation. This directly influences the firm's choice in technological strategies and capabilities.

Firstly, the state can be actively influencing economic development via *direct involvement*, Fainshmidt et al (2016) refers to this aspect in his work as "direct state dominance". According to Zhang and Whitley (2013), the degree of direct state influence over the national economy depends on the level of direct involvement in economic production which usually takes the form of majority or full state ownership of firms. This is particularly important for understanding the case of China as state owned firms still account for 80% of the value of stock market. It shows that the state retains strong direct intervention into the economic environment. It justifies featuring the role of the state as one of the dominant institutional factors for understanding the choices in firms' technology strategy and capability.

Secondly, states can intervene via *indirect involvement* such as capital provision, favouritism, and participation or intervention into corporate governance in the national economic environment (Fainshmidt, 2016). For example, the Chinese government regularly chooses which IPOs are approved on the national stock exchanges (Tian, 2011). This effectively determines the access of firms to the domestic capital market. We expect this to affect the resources available to the firm impacting on the choice of technology strategies and capability. This will further be discussed in the China focused section 3.2.2. According to research conducted by Fan, Wong, and Zhang (2007), 27% of the CEOs within 790 recently privatised firms in China are former or current government officials. This illustrates the direct levels of influence of the state on corporate governance of domestic firms. In turn this will affect the firm's priorities and its technology strategies and capabilities.

In conclusion there are various kinds of influence carried out by the state on the shape of national economies. According to Whitley (2007) different kinds of regimes support different patterns of economic organisation to be established on a national level, especially for corporate governance, authority sharing, and the kinds of organisational capabilities that are developed by domestic firms. Through policies and state structures a cohesive and distinct national institutional context is created. The State is forming an economic environment and therefore implements a substantial pre-definition on the attitude of the key economic actors towards each other in terms of opportunism, competition, and collaboration.

2.2.2 The Financial System – Why is financial system important for firms technology strategy and capabilities?

The following section will look at the financial system as part of the key national institutions and as to how capital is acquired and distributed (Davis & Marquis, 2005). Generally a financial system has two essential functions. According to Rajan and Zingales (1998) these are to channel resources to their most productive uses and to ensure an adequate return on investment to the financier. National financial systems do differ in a broad number of dimensions. However Whitley (1999) distinguishes between credit and equity markets as the main differentiations of any financial system. The features of how capital is made available and how it is priced are widely accepted by scholars as a crucial feature of distinction.

Hsu et al (2014) stated in their work that innovation requires functioning financial markets as they play a critical role in reducing financing costs, allocation of scarce resources, evaluating innovative projects, and monitoring managers. Further, it needs to be acknowledged that the state often acts as a capital provider outside of traditional private sources, particularly in countries where the state has been an owner of factors of production or financial institutions. In fact, when states or families assume the role of capital provider they substitute for financial markets and hinder their development (Steier, 2009; Schneider, 2009). It illustrates the impact of financial systems on the access to financial resources for domestic firms. In turn this affects the resources available to firms affecting their choice in technology strategies and capabilities. This is particularly important for developing economies and as such will be discussed in a China specific focus in section 3.2.2.

Vitols (2001) argues in his work that the state involvement in credit allocation turns the national financial system into a powerful tool to resolve market failure problems in which political and social considerations take reason over economic ones. In a similar context but with a more negative connotation this element of state interference can be associated with misallocation of capital due to misinterpreted market trends and political patronage (Calder, 1993). For the sake of clarity, this chapter will focus on the features of availability and pricing of capital as these are the key aspects for differentiation in the literature (Beck & Levine, 2002; Demirguc-Kunt & Asli, 2002; Chinn & Ito, 2006).

The *capital-market-based financial system* is defined by capital being raised and allocated through liquid markets with trading and pricing mechanism similar to those of the commodity market process (Zysman, 1994). As a result shares in this system can easily be traded and ownership transferred without complications. This limits the shareholders commitment to the short-term whilst encouraging strong levels of corporate control (Whitley, 2007). The *credit-based financial system* is characterised by weak capital markets with only little influence on the allocation of capital within the overall national financial system (Cox, 1986). Instead of being traded in a commodity market process, capital is distributed through the dominant institutions in an administrative process. As a result of this administrative process shares are not easily traded as it is the case in the market-based system. This leads to a stronger long-term commitment of the financier and firm locking them into each other's fate. The financier becomes more informed and involved into the decision making process which allows firms to pursue long-term goals (Whitley, 2007). Firms operating in a national environment with a robust credit or equity market are more likely to undertake innovative activities, partially due to competition among capital providers (Cornaggia et al, 2015) and enhanced stock market liquidity (Fang, Tian, & Tice, 2014). This shows the direct influence that the means and access of capital have on firm's willingness to engage in investing into innovation activities. It validates the choice of financial systems one of the dominant institutions affecting firm's technology strategies and capabilities. In China the financial system is credit based and state-owned bank dominated. This has implications on the availability and price of capital depending on

the relationship between firm and the state controlled banks. This will be further discussed in section 3.2.2 covering the financial system of China.

In the next section of this chapter the focus of attention will be moved from the financial system to the system of skill development and its associated impact on firm features.

2.2.3 The Skill Development System – Why is skill development important for firms technology strategy and capabilities?

Similar to the financial system a state's skill development system is strongly influenced through national institutional features on aspects such as labour relations, skill formation, and employment regulations. Generally speaking national systems of skill development differ in the ways workers are recruited, trained and utilised within a labour market (Ashton & Sung, 2000). The skill development system is characterised as set of interrelated institutions namely the education and training system on the one hand, and the labour market and its associated organisational form on the other (Whitley, 2003; Crouch, 2005; Ashton & Sung, 1994; Thelen, 2004; Streeck, 2001; Green & Sakamoto, 2001).

Hall and Soskice's (2001) general differentiation of skill formation based on the variations of capitalism is in close logic to the above. Using their concept of *co-ordinated* and *liberal market economies* it is possible to generally differentiate the education and training as well as the labour market in particular national institutional concepts. This refers to the earlier elaborated interdependence of national institutional features and firm feature characteristics discussed in section 2.2.1 (Thelen, 2004; Smith, 2005). Advocates of this particular theoretical concept argue following the logic of the original concept by Hall and Soskice that *co-ordinated market economies* with their long-term oriented financial markets, the greater extent of coordination amongst employers, and the various forms of labour and management cooperation are associated with this particular kind of economy and in turn shape the national education and labour system. Opposed to the co-ordinated one, the *liberal market economy* with its short-term focused financial markets, fragmented employers, and the generally speaking more adversarial industrial relations system is bound to evolve a completely different national education and labour system. These institutional arrangements have a considerable impact on the degree of employee-

employer opportunism within a national labour market, the degree of training of employees, and the development of organisational capabilities on a firm level. The latter in particular refers to the willingness of employee and employer to facilitate the development of firm specific skills and knowledge (Grimshaw & Rubery, 1998; Whitley, 1999; Thelen, 2004). In summary, the above aspects influence the flexibility of labour markets. This in turn impacts the efficient allocation and mobility of skilled workers allowing firms to change quickly and develop a higher capacity to capture innovative opportunities (Pezeshkan et al, 2016). These opposing concepts influence what kind of skill sets are available for firms to utilise in future learning and improvement processes (Whitley, 2003). Hence the skill development system is of great importance for firm's choice in technology strategies and their capabilities.

As stated earlier in this section the differences in the education and training system as well as labour market can be used as the basis for differentiation according to two particular aspects. According to Whitley (1999) training systems can be differentiated based on the value that is attributed to vocational training. The generalist training system is, for example associated with France, and characterised by its low social prestige for vocational training. The opposed concept is the dualist one that is predominant in Germany and emphasizes a strong focus on vocational training with a solid social reputation (Thelen, 2004; Streeck, 2001; Green & Sakamoto, 2001; Greenhalgh, 1999). These skill sets are further influenced by the degree to which employers, unions, and the state institutions are participating in such training. This shapes the skill sets available that firms can utilise for innovative output (Verheul et al, 2002). In many industries established competencies erode quickly and firms are required to continuously create new ones through innovation with educational systems playing a key role in producing skilled workers capable of innovating (Lundvall et al, 2002). As such they impact the firm's technology strategies and capabilities.

In summary, the national system of skill development revolves around how labour is recruited, trained, and utilised within the national economy. The composition of the labour market and the quality of skilled labour available to firms has an impact on the firm's ability to pursue their chosen technological development strategy. Further, it is important to firms to what degree the national skill and development system encourages employee contribution and learning within firms to fully utilise the

potential of its workforce. The willingness of firms to invest into their labour force depends greatly on how well skilled labour can be retained and company specific training is encouraged. This differs based on each individual national set up and as such needs to be considered on a country by country basis for further analysis. This topic will be revisited in section 3.2.3 and discussed further in a Chinese context.

2.2.4 The Authority and Trust System – Why is authority and trust important for firms technology strategy and capabilities?

The role of the authority and trust system is more of an overarching one that exerts influence on all individual key institutions and as such shapes the national institutional context as a whole. Therefore, it is inevitable to take a closer look at both the system of trust generation and authority compliance.

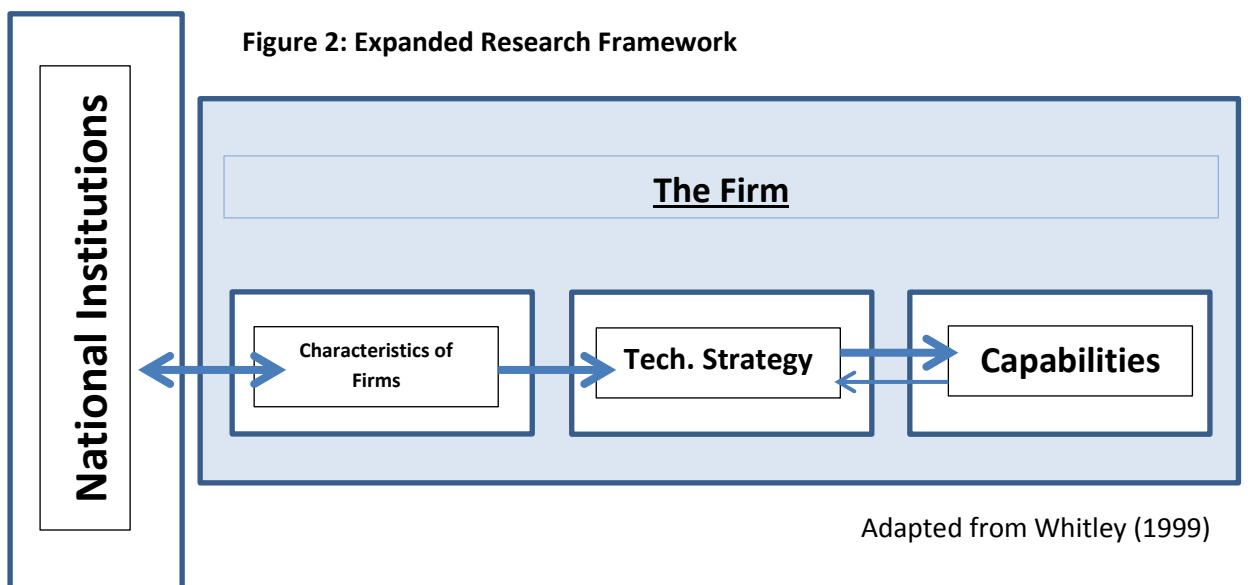
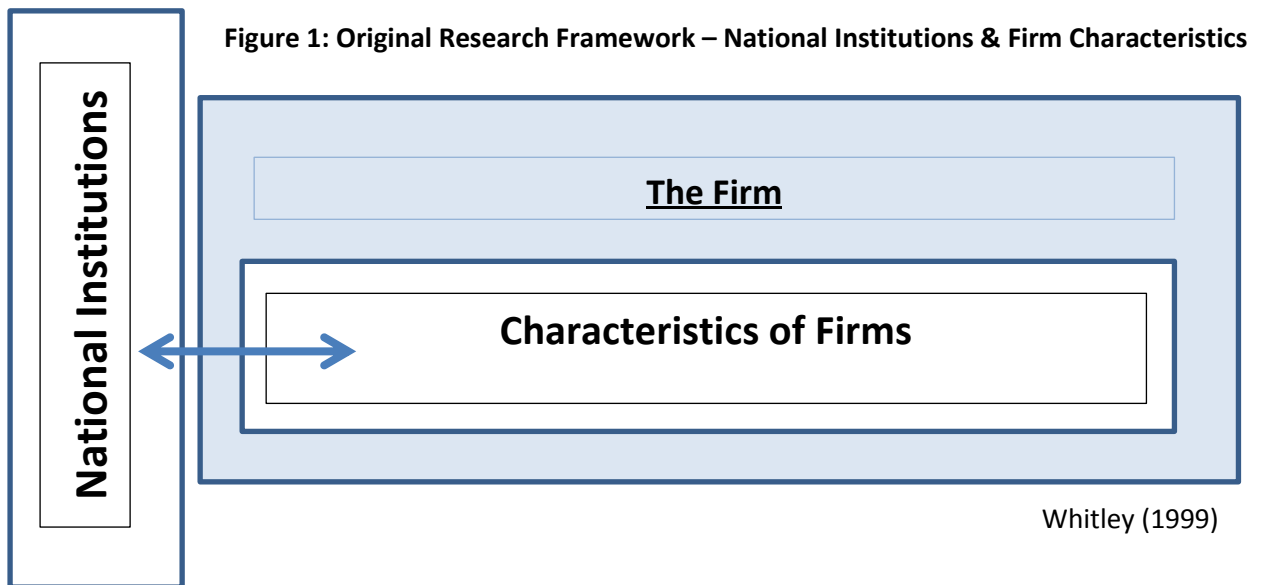
The concept of trust is in a sociological context perceived as a rather collective than an individual attribute. According to Barber (1983) trust is defined as existent in social systems in the sense that members of that system act in accordance with the expectations constituted by the presence of each other. Trust can be differentiated into several forms based on the foundation it is rooted in. In the literature trust is differentiated into: competence, contractual, and goodwill based trust (Dore, 1983; Gulati, 1995; Hanna, 1996; Whitley, 1999). Transferring this originally sociological typology into an economic context it depends on the strength of national institutions as generator and guarantor of mutual trust between different economic actors. With trust being the basis for cooperation, a weak institutional trust system in turn leads to personal relations being the most important basis for trust and thereby limiting the degree of wider collaboration beyond personal connections within an economy (Robson et al, 2009). The more reliable these institutions, are the more trust can be based on reputation, contracts, and compliance, with economic actors more willing to invest into collaboration beyond personal relations (Whitley, 1999). According to for example Meagher (2007), lack of trust between the private sector and government institutions has a negative impact on the innovative activities of firms. This shows the importance of trust systems on the firm and its technology strategies and capabilities.

Closely associated with the concept of trust is the one of authority. Within the system of authority the relation between superior and inferior are governed by a wide number of different norms and rules (Eckstein & Gurr, 1975). The system of trust and authority

has a significant influence on economic relations within a society and the willingness to engage into cooperation beyond an established personal network. The formal authority systems can encourage or discourage the delegation of decision powers down to an inferior level based on the regulation through formal contracts. These contracts usually are limited finite and therefore do limit the willingness for long-term cooperation. Informal authority systems with their reluctance to limit superior decision power as a logic consequence not only cause a limit to the willingness for cooperation to emerge, but also hinder the capabilities needed to develop. Communal authority being built around a convolute of shared values cooperation on a firm level can be easier established by referring to these as guidance (Kong, 2009). In other words, the degree of to which economic actors trust each other and institutions is an organising principle for the behaviour of and coordination amongst firms and employees (McEvily et al, 2003). This means that firms willingness to cooperate with external and internal stakeholders differ based on the trust and authority system and as such impacting on the firm's technology strategies and capabilities.

In summary, it can be outlined that the system of trust and authority not only influences the willingness for cooperation within a firm but also such aspects as ownership selection and employer/employee relations (Whitley, 1999). This in turn as logical consequence influence the firm's ability to develop key characteristics based on employer/employee relations and contribution such as joint learning. Further, the wider cultural implications affect the firm's general behaviour of how they interact and cooperate amongst each other.

The below tables provides an overview of the theoretical framework guiding the considerations of this work. Starting point for the theoretical framework are Whitley's (1999) considerations on national institutions and characteristics of firms (Figure 1). In a second step, these considerations are placed into the question of how firm innovation is impacted. Expanding on Whitley's (1999) initial thoughts the new extended research framework introduces the influential linkage between characteristics of firms, technology strategies (Freeman, 1992), and capabilities (Whitely, 2007). While national institutions can be considered an external influence on the firm, the firm characteristics and capabilities are internal influences on the firms' choice in technology strategy.



The previous section discussed the role of the national institutions as a starting point for the further theoretical thoughts. The national institutions are shaping the external setup in which firms can develop firm characteristics and as such have a direct impact on firms. The firm characteristics in turn are impacting which technology strategy developing firms can realistically implement.

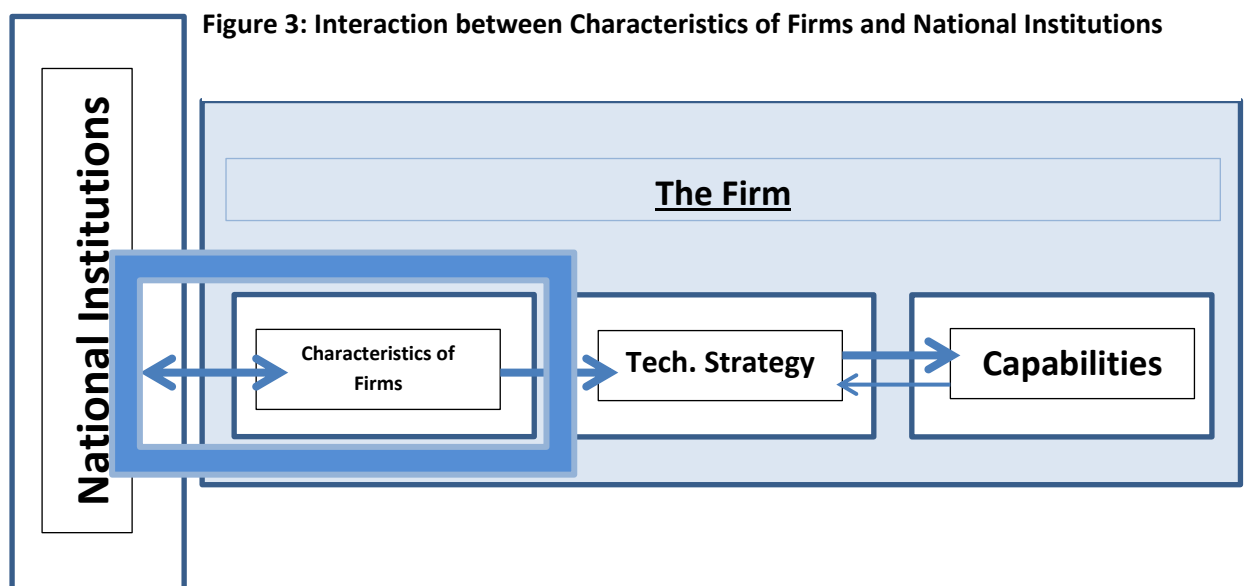
The linkage between firm characteristics and technology strategies will be discussed in more detail in section 2.4 of this work. Following the logic laid out in the above

framework the technology strategies in turn influence the capabilities that domestic firms can develop. Simultaneously the already existing capabilities of a firm have an impact on the choices in technology strategies as both aspects of the firm are closely related to each other. In section 2.5 this interdependency between technology strategies and capabilities will be discussed. The following section will elaborate on the role of firm characteristics of firms

2.3 Characteristics of Firms

The national institutions shape the economic environment as a whole, while it is the key characteristics that influence the nature of the domestic firm. Firms are the smallest unit of economic coordination on a national level and are of considerable importance as they coordinate usage of financial resources and create employment.

According to Whitley (1999), firms are understood as units of economic coordination and control under common and unified ownership developing distinctive capabilities through the authoritative direction of employees on the basis of employment agreements. This definition is similar to the definition of Penrose (1959) that defines firms as administrative structure that add value to human and material resources through the collective organisation of work under managerial decision making. However, this definition is narrowly focused on the internal aspects shaping governance characteristics and leaves the external ones unconsidered. This framework will broaden the view onto firm characteristics by taking both internal and external factors for influence into consideration (Aguilera et al, 2015). Further, the definition of firms and characteristics can be very different in developing countries such as China due to its distinctive institutional characteristics. Therefore the key characteristics of firms as defined by Whitley (1999) allow for systematic understanding of the interaction between firms and institutions (Figure 2).



Within this work, firm characteristics are understood as the features outlining the owners, managers, employees and business partners' influence on the decision process to determine the firm's main objectives and its resulting behavioural consequences (Whitley, 1999). The dominant goals of the firm can be used to further differentiate a firm's approach on capability development. These two lines of differentiation can be summarised as in the table below:

Table 2: Characteristics of the Firm

Characteristics of the Firm	
<i>Firm Characteristics:</i>	
1) To what extent are managerial decisions constrained by financiers and owners?	
	(i) Levels of managerial decision autonomy
	(ii) Basis for evaluation of manager performance
	(iii) Basis for remuneration of managers
2) To what extent are managerial decisions constrained by employees?	
	(i) Inclusion of skilled workers in the decision process
	(ii) Level of influence of workers unions on the decision process
3) To what extent are managerial decisions constrained by business partners' interest?	
	(i) Scope of cooperation between buyers and suppliers
	(ii) Scope of cooperation between competitors
4) What are the dominant goals of the firm?	
	(i) Family wealth and reputation
	(ii) Return on investment to shareholders
	(iii) Firm growth
	(iv) Technical excellence

(adapted from Whitley, 1999, p.67)

The characteristics of a firm are influenced by the above stated four factors. These are considered helpful to guide the analysis of management and strategic alignment of the firm. The four factors are based on the relative influence of employees, business partners, and competitors on the managerial choices and their dominant objectives. They further incorporate the role of power balance within a firm between the owners and financiers on one side, and the executing side of managers on the other. Further, these internal aspects of the firm are impacted by external ones through the national institutional environment. In summary, this leads to and shapes the predominant goals the firm strives to achieve impacting on the firm's choice in technology strategy and capabilities (Whitley, 1999).

The firm characteristics of firms differ according to the power balance of owners and managers and its resulting influence on the firms' predominant goals. According to Aguilera & Jackson (2003), ownership shapes the interaction between owners of capital, labour, and management. Based on Whitley (1999), firm characteristics differ based on the levels of managerial decision autonomy and the basis of evaluation of managers performance. The level of managerial decision autonomy given by financiers and owners is partly dictated by the legal frameworks instated by the respective national government. While the evaluation and levels of remuneration of managers are closely linked to the financial institutional system in section 2.2.2 under which the firm operates. More generally speaking, management control is strongly influenced by the availability of capital and resulting obligations towards the creditor. The US and UK system often can be found as an example within the literature as cases of management control constrained by strong capital markets (Whitley, 1997). Shareholders often function as fund managers and therefore are motivated to pursue adequate returns on their investment, as the ownership is separated from control (Cosh & Hughes, 1987). This shapes the evaluation of manager's success and their remuneration. Further, it has an impact on the firm's ability to generate capital within the highly liquid capital markets, which influences the dominant goals within management (Kumar, 1988). The opposing concept is manager control being constrained by strong credit controllers such as banks, which often is less fragmented in terms of numbers of shareholder. In this case, due to the considerable commitment by the shareholder, the management can pursue a more long-term focus as the determinant for success is not short-term revenue; allowing to aspire to goals which need a stronger commitment such as growth and technical superiority (Huddart, 1993). Remaining power relations can be characterised by substantial autonomy of management which not necessarily need to carry a separation of shareholders and management. The level of authority granted and the way management is evaluated guide the firms dominant goals, and as a result, the choice in technology strategy and capabilities. Hence this aspect of governance characteristic is a justified choice to evaluate the firms technological choices based on the firm's key objective. The dominant goals of the firm will be discussed at a later stage within this section.

A second factor useful for differentiation is the degree in how far managers are constrained in their decision autonomy by employee interests and concerns (Whitley, 1999). This can be closely associated to the already mentioned role of the state, as well as the influence of the dominant skill development, trust and authority system within a national economy. The decision autonomy of the management considering the firm's strategy and objectives can be restricted by workers interest, which either can be based on legal codetermination as in the 1976 German Codetermination Act or the voluntarily acceptance of worker representative participation by management (Strauss & Rosenstein, 1970; Mertens & Schanze, 1979; Bartoelken & Eschweiler, 1982; Boersch-Supan, 1998). The third limitation of managerial decision autonomy is associated with the national trust and authority system and copes with the resulting constraints through the need to incorporate the interests of business partner into the decision making process. Firms with high levels of employee influence are more likely to pursue long term goals which will impact their choice in technology strategies and subsequent capabilities.

Firms can be differentiated based on the impact that the interests of business partner have on the firm's managerial decision autonomy. Firms establish various types of business relationships for different purposes such as to commercialise outputs to buyers or access inputs via suppliers (Hite and Hesterly, 2001). Business relationships provide firms with access to various types of resources such as information, market access, and innovation opportunities (Oviatt & McDougall, 1995; Jack & Anderson, 2002). This is particularly of importance to firms in developing economies as it can be one way for firms to overcome ineffective and inefficient national institutional environments (Roth and Kostova, 2001; Ferreira and Li, 2008). The scope of cooperation between business partners is limited by the respective legal limitations set by the state and further limited through the trust system in place. In a cooperation of firms each individual management needs to take the economic objectives of the respective participants into consideration, and in this context, Japan is often mentioned as an example. According to Whitley (1999), authority sharing has major implications for determining the firm's goals and strategies with the key aspect of this characteristic of firm behaviour being the stability and authority of such networks and the degree to which firms are locked into them. The scope to which firms are willing to

cooperate with each other in terms of sharing knowledge and information is important to the type and quality of innovative opportunities a firm is faced with. This as a result impacts the firm's choice in a feasible technology strategy as well as their capabilities. It is therefore important to understand the interaction of firms and their business partners. This will further be discussed in the context of China in section 3.4 of this work.

According to Whitley (1999), the dominant firm goals can be categorized into the following differentiation stating the dominant goals of the firm as (i) personal and family wealth, (ii) high returns on portfolio managers, (iii) growth in assets, turnover, and markets, and (iv) increased technical excellence and reputation. These four goals often coincide with each other, however according to the ownership and management constraints elaborated earlier, there can be a clear alignment drawn between those features. A company lead by a management highly constrained by strong capital markets will need to have a significant focus on high returns for portfolio managers, while a company under owner management will have a stronger interest in wealth accumulation and a company with a high degree of employee codetermination will be more interested in longterm growth for the sake of secure employment. This in turn will reflect the strategic choices made by the firm in regards to their technology strategies and capabilities build. Hence there can be a clear alignment drawn between the dominant goals of the firm and its choices which will be further discussed in section 2.4 to come.

2.4 Technology Strategies for Firms in Developing Economies

Firms operating in developing economies will eventually find themselves in a position in which they need to consider different choices to improve their technological capabilities to catch up with established firms in international markets. The needed technology usually sits with the 'foreign frontier firms' (FFF) in established economies, hence it being key for the 'late-comer firm' (LCF) to gain access to this technology to improve its own capability to be able to develop own technologies. Foreign frontier firms are understood as firms leading in their industry in terms of product technology and production efficiency. Late-comer firms (LCF) are defined as a late entrant to an industry, initially lacking technology and market access, with its main focus on technological catch-up, and very few competitive advantages besides low costs (Matthews, 2002).

The issue is the manner of the transfer and its timing within the development time line of the developing firm. Commonly LCFs initially focus on obtaining production capabilities in form of licensing or joint-ventures, and at a later stage shift efforts towards building independent technological capabilities (Xia et al., 2009). Core to the technological catch-up are the development of the firm's technological capabilities (TCs). Technological capabilities are understood as the ability to use technological knowledge efficiently to assimilate, use, adapt, and change existing technologies. This, in theory should, ultimately allow the late-comer firm to create new technologies resulting in new products and processes (Xiao et al., 2013).

Freeman (1992) developed four main technology strategies in his work: (i) dependent, (ii) imitative, (iii) defensive, and (iv) offensive (Table 3). These four strategies will be individually discussed in more detail in the following sections below.

Table 3: Overview of technology strategy choices for developing country firms

Technology Strategy Choices for Developing Country Firms	
<i>Technology Strategies:</i>	
1) Dependent Technology Strategy	
(i) What firm characteristics are needed?	<ul style="list-style-type: none"> a. manager performance based on short term evaluation b. limited skilled worker inclusion
(ii) Which priorities support the choice?	<ul style="list-style-type: none"> a. Return on investment b. Firm growth
2) Domestic or International Imitative Technology Strategy	
(i) What firm characteristics are needed?	<ul style="list-style-type: none"> a. manager performance based on long term evaluation b. inclusion of skilled workers in decision making c. cooperation between suppliers and buyers
(ii) Which priorities support the choice?	<ul style="list-style-type: none"> a. technical excellence b. increase in family wealth and reputation
3) Defensive Technology Strategy	
(i) What firm characteristics are needed?	
(ii) Which priorities support the choice?	
4) Offensive Technology Strategy	
(i) What firm characteristics are needed?	
(ii) Which priorities support the choice?	

The above and below table provide an overview of the theoretical linkage between the different technology strategies available to developing firms and the respective firm characteristics needed for a successful implementation of the chosen strategy. Different technology strategies have different requirements towards the governance characterises of the firm as highlighted in the table below.

Table 4: Interdependencies between technology strategy and firm characteristics

	Domestic Imitative Strategy	Dependent Strategy	International Imitative Strategy	Defensive Strategy
Managerial decisions constrained by financiers and owners	Direct Owner Control	Disengaged shareholders	Engaged Shareholders	Engaged and expert shareholders
Managerial decisions constrained by employees	Moderate workers inclusion	Low workers inclusion	Moderate/High workers inclusion	High workers inclusion
Managerial decisions constrained by business partners' interest	Moderate business partner inclusion	Minimal business partner inclusion	Moderate/High business partner inclusion	High business partner inclusion
Dominant Goal of the firm	Firm Growth	Return on Investment	Family wealth & reputation; technical excellence	Technical excellence

(Adapted from Liu and Tylecote, 2016)

Building on Freeman's work, Liu and Tylecote (2016) further divided the imitative strategy further into domestic-imitative strategy and international-imitative based on the origin of technology (Table 4). Offensive strategy is not further explained in the above figure, as it is the final stage of the ideal path to technological ascent and as such is not of direct relevance to this research. The differentiation between domestic and international imitative strategy was introduced to better reflect the choices faced by developing firms in China. This section will utilise their work and solely focus on dependent, domestic-imitative, international-imitative, and defensive technology strategy.

2.4.1 Dependent Strategy

The dependent strategy is turning to foreign frontier firms as a source of technological capabilities. The nature of the strategy is passive with a focus of achieving fast results in improvement of production capabilities and is considered to be less challenging than any form of imitative strategy (Xiao et al., 2013). It can be argued whether or not this strategic approach is more ambitious than a domestic-imitative. While it does turn for

an international partner and in theory more advanced technology, there are severe constraints to learning and improving the LCF's own technological capabilities.

Technology is accessed through the late-comer firm agreeing with a leading foreign firm to supply them with all the needed licences, blue prints, key components, and training in order to manufacture a certain product (Xiao et al., 2013). The bargaining power of the domestic firm is dependent on several factors: the financial buying power, the size of the domestic market, and the access restrictions in place for foreign firms. The bigger the size of the domestic market and the stronger the access restrictions for the entry of foreign firms, the more likely the foreign firm will be to share their technology with the domestic firm. This often is done via means of cooperation, such as joint-ventures, as not to lose full control over the technology given (Liu & Tylecote, 2009).

As appealing as the fast access to technology is to late-comer firms, there are limitations, such as a reluctance to pay for the required technology licences or even a lack of the financial resources to do so. Further, there might not be a foreign frontier firm interested in sharing its technology with the respective domestic firm (Xiao et al, 2013). Besides these limitations the potential for improving the LCF's technological capabilities is comparatively low compared to an imitative one. To illustrate: a late-comer firm acquiring a turn-key plant from a frontier firm with all licences, components, and technical training needed to produce the final product has only very limited incentive to un-bundle this technology and obtain their own capabilities for production the technology itself.

Firms pursuing a dependent technology strategy need good access to financial resources. Any foreign technology will need to be acquired and large-scale production facilities will need to be set up, which is associated with considerable costs (Liu and Tylecote, 2016). Further, their firm characteristics can be expected to be rather result driven than long-term focused. Managerial control will most likely be characterised by disengaged shareholders. The labour coordination can be expected to be modelled after a Taylorist concept, characterised by a clear differentiation between a small managerial elite and a large workforce governed by a clear set of rules (Whitley, 1999). With regards to alliance coordination, the contractual based relationship between the

foreign technology firm and the respective late-comer one leaves very little need for any further cooperation or alliance (Liu and Tylecote, 2016). The FFF normally provides everything needed to start production and therefore renders any technological learning unnecessary.

2.4.2 Imitative Strategy

The *domestic-imitative strategy* is characterised by developing firms following a stronger domestic firm as a source of technology. This strategic approach is least in ambition, however, very effective as more advanced domestic firms will be copied by late-comer firms in the respective industry (Liu and Tylecote, 2016). The nature of this strategy is reactive, with the LCF following the advanced domestic firm in its technological development.

The LCF can obtain the needed technology from the advanced domestic firm, either through the means of imitation such as reverse engineering and hiring key employees. Another way to gain access would be to identify key suppliers, such as component, service, or capital providers, and initiate a relationship to start buying from them. It is to be expected that LCFs will follow a mixed approach on the above outlined options to maximise the amount of technology obtained. However, this particular strategic approach will also mean that the late-comer firm will have to follow behind the respective technology leaders in their industry until they are capable innovating on their own.

In order to do so, the LCF will need to seek independence from the advanced firm through unbundling the obtained technology and learning to utilise it in their own way to become competitive. The domestic-imitative strategy has the disadvantage on any dependent strategy that it will initially take longer to build technological capabilities (Xiao et al., 2013). This will have an impact on the LCF's competitiveness within the domestic market at early stages of development. However in regards to potential learning the domestic-imitative strategy is leaving the LCF with more scope for improvement than the respective dependent strategy. The domestic-imitative strategy allows the developing firm to build own technological capabilities. Moving forward this will place the firm in an advanced position to shift from any imitative strategy to a defensive one at a later stage of development.

Firms pursuing a domestic-imitative strategy limit themselves within their national borders and will only be able to catch-up to the leading domestic firms, but not the foreign technological leaders. These firms are left with only limited potential to achieve international relevance within their industry. It is a strategy typically chosen by smaller owner controlled firms operating on smaller scales (Liu and Tylecote, 2016).

The *international-imitative strategy* differs to the domestic imitative strategy only in that the late-comer firm is not reactive to the strategy of a domestic, but an established foreign firm. The approach on obtaining the respective technology is also the same as with the domestic-imitative strategy. Again it can be obtained by reverse engineering, obtaining access to key suppliers, or poaching employees.

In comparison to the domestic-imitative strategy, the international one is significantly more difficult. While it offers possible access to foreign technology, it is harder to gain access to as the firms are operating in different national economies. This will make it physically and financially harder for the late-comer firm to access the frontier firm's suppliers, employees, and customers in order to gain insights into their technological capabilities (Liu et al., 2015). Reverse engineering plays a significant role in the international-imitative strategy. It is still an international-imitative strategy even if LCFs are paying for licences or similar supporting activities by frontier firms, as long as the obtained technology is unbundled and each element of the product is acquired separately. Hence, the late-comer firm is in need to bring the different components together in an effort of system integration. By doing so the firm should be able to lower its dependence of the foreign firm gradually and at the same time increase its own innovative capability (Liu and Tylecote, 2016).

All these technology strategies need to take the limitations imposed on them through existing intellectual property rights (IPR) into account. The dependent strategy is usually the least problematic as the foreign firm and patent holder is directly involved and will be remunerated for its participation (Liu and Tylecote, 2016). The levels of resistance to transfer technology to late-comer firms, either bundled or un-bundled, will increase once the firm reaches the technological frontier and will be perceived gradually as a potential rival (Xiao et al., 2013). The more the LCF develops and generates their own patentable technologies the more they become reliant on using

IPR as a tool for protection forcing them to play by its rules. This in turn forces the late-comer firm to eventually switch from an imitative to a defensive technological strategy.

In order to successfully implement an international-imitative technology strategy the firm is required to have long-term focused and engaged shareholders willing to take the initial lower levels of competitiveness for the sake of greater potential in capability development. Also the investments made are of low visibility and do not offer a direct return on investment quite the contrary they will usually only pay off at a later stage (Xiao et al., 2013). Further, this strategy is less demanding in regards to its financial requirements in comparison to the dependent strategy. As a result firms are more likely to finance an international-imitative strategy through self-financing instead of relying on external financial sources (Liu and Tylecote, 2016). Looking at work management characteristics a successful implementation would require considerable workers discretion and involvement at limited levels of task fragmentation to allow for obtained technologies to be absorbed and unbundled (Whitley, 1999). Last but not least, the nature of this particular technology strategy calls for joint problem solving and it would be highly beneficial to firms to pursue considerable levels of domestic and international alliance coordination.

2.4.3 Defensive Strategy

The defensive strategy is the first step away from a dependent to an active technology strategy. Any firm pursuing a defensive strategy is developing its own genuinely new technology through R&D and will usually try to protect its technology through patents (Xiao et al, 2013). The defensive firm will try to protect its technology from firms following and imitative strategy usually based in developing economies and from firms with an offensive strategy threatening their established technology from time to time through breaking innovations. As stated in the previous part of this work, the late-comer firm is expected to move away from an imitative strategy towards a defensive one as its development continues and it is starting to be faced with more resistance through Foreign Frontier Firms (FFFs) and the limitations on imitation through increased IPR constraints.

The minimal effort approach on a defensive strategy is to invent around existing technology, meaning that the late-comer firm identifies what the current frontier

technology does and re-invent it in a slightly different way which allows them to gain patent protection for their derivation of the technology (Liu and Tylecote, 2016). This approach can also include the production process and can lead to opportunities for further improvements in the fields of production engineering.

In order to do so, the respective firm needs to have a highly developed and well directed approach on R&D which requires not only substantial and stable financial resources but also the needed capabilities to put the capital to use. Due to these requirements the outlook in future potential to enhance its technological capabilities are significantly higher than compared to the previous dependent of imitative strategic approaches (Xiao et al, 2013).

2.4.4 Offensive Strategy

The last and most ambitious approach on technological strategy is the offensive strategy. It is characterised by firms strive to be the leaders in new products in technology within their industry. These products are developed based on own R&D work. Due to the highly innovative nature of the products they are often closely linked to the respective science base (Liu and Tylecote, 2016). A firm following a successful offensive strategy is actively advancing and contributing to the technological frontier on an international level. Hence, an offensive strategy is normally not of interest for late-comer firms in developing economies and is stated here for the sake of completeness, rather than for further analysis.

In summary, each individual technology strategy can be associated with a certain set of capabilities needed in order to be implemented successful (Table 5). The below table gives an overview of level of constraint between the above discussed technology strategies and the financial, organisational, and innovative capabilities of the firm.

Table 5: Technology strategies and the different levels of required firm capabilities

	Domestic Imitative Strategy	Dependent Strategy	International Imitative Strategy	Defensive Strategy
Financial Capabilities	Low Financial Capabilities	High Financial Capabilities	Moderate Financial Capabilities	High Financial Capabilities
Organisational Capabilities	Moderate Managerial Capabilities	Low Managerial Capabilities	Moderate Managerial Capabilities	High Managerial Capabilities
Innovative Capabilities	Moderate levels of independent R&D	Low levels of independent R&D	High levels of independent R&D	High levels of independent R&D

(Adapted from Liu and Tylecote, 2016)

For example, the domestic imitative technology strategy is the least demanding one in regards to the various forms of firm capabilities. In comparison, the international imitative technology strategy is already more challenging in regards to the firm's capabilities. It demands both higher financial and managerial capabilities as compared to the domestic imitative strategy and most of all it requires high levels of independent R&D in order to incorporate the unbundled technology obtained. Further, each of the discussed technology strategies bears different potential for further development and enhancement of the firm's organisational capabilities. This links back to the presented theoretical framework in section 2.4 of this chapter, as it exemplifies the reciprocal relationship between the choice in technology strategy and the developing firm's organisational capabilities.

2.5 Organisational Capabilities

The following section will move away from technology strategies and turn the focus towards organisational capabilities. In order to allow for a differentiation of predominant typologies for firms within market economies the analysis of capability development has proven to be a useful tool. The formation process and the focus on organisational capabilities differ significantly throughout different market economies and can be linked back to the key national institutions. Prahalad and Hamel (1990) in their renowned work about core competences in corporations approach this issue from a different perspective. Their commentary on competencies is also applicable to organisational capabilities and strategies as discussed in this chapter. As they state in their work:

“The real sources of advantage are to be found in management’s ability to consolidate corporate wide technologies and production skills into competencies that empower individual businesses to adapt quickly to changing opportunities.”

(Prahalad & Hamel, 1990, p. 81)

This quote may have been phrased in face of a different research question and yet does embrace all the same factors that come into consideration when organisational capabilities are used to analyse firms. The underlying basis for theoretical differentiation of firm types are the questions of how, what kind of, and in what timely manner, organisational capabilities are developed (Whitley, 1999).

Starting with the question of how these capabilities are developed the analytical focus lies on the integration of employees into this particular processes, which is distinctly based on the national labour market institutions. If the labour market is organized based on market principles that allow firms to pursue a flexible approach on their labour relations, work force is considered a commodity by the firm. This can be even further encouraged by labour regulations supporting a hire and fire mentality granting a greater degree of flexibility to cope with short term constraints (Casey & Keep, 1999). In this setting, often associated with the Fordist system of production, labour is seen as a standardised input that can be replaced as demand changes. By doing so it limits the trust within the employee-employer relationship and the willingness of employers to invest into the employee’s skill set. While this approach allows a high

degree of flexibility, it has an inherent danger to cause a shortage in skills and does limit the worker's contribution towards the development of capabilities (Hall, 1993; Whitley, 1999). The degree of employee integration in the process of capability development within labour relations based on contractual regulation is considerably higher. This is due to the more long term commitment between employee and employer causing knowledge accumulation within the employee's skill set; Allowing for a higher degree of contribution (Becker & Murphy, 1992; Matusik & Hill, 1998). Incremental innovation calls for this particular input on a worker's level to be realized (Ettlie & Bridges, 1984). In summary the first aspect can be described as *the contribution of employees to the development and improvement of organisational capabilities* (Whitley, 1999, p.73).

The second question in need of consideration is: which set of capabilities does a firm focus on in order to compete within the market? Based on the works of Best (1990) and Lazonick (1990) two general types of firms can be distinguished according the strategy they pursue. Based on the mode of competition firms can follow an adaptive strategy by focus on either price reduction through cost reduction, or on differentiation through incremental innovation and a focus on improved quality and technology. The second general typology is based on a more entrepreneurial strategy with a strong focus on developing innovative capabilities in order to withstand the competitive forces within the market economy. As opposed to incremental innovation this strategy is based on disruptive innovation that introduces new sets of product attributes which are different from those currently in demand by mainstream customers and therefore allow for new products and applications to arise (Bower & Christensen, 1995; Christensen, 1997; Markides, 2005). This second feature of differentiation is closely conjoint with the first one, as firms striving for disruptive leadership will be more dependent on employee's contribution to process and product improvement as compared to those pursuing a adaptive strategy by focusing on cost reduction. Generally speaking this feature is summarized as *the extent to which firms develop innovative capabilities* (Whitley, 1999, p.74).

The third and final question to answer would be the ability inherent to the strategy to allow for quick adjustment to changes in the market and needs of customers. According to the strategy chosen different patterns are followed by firms to meet the

demand of customers with a resulting influence on their flexibility towards the changes mentioned above (Storper & Salais, 1997). This dilemma between flexibility and limitation of cost is not new to the literature and has been extensively discussed (Miles & Snow, 1978; Snow & Herbiniak, 1980). So in McKee and Varadarajan:

“At one extreme, the organization can maintain an external focus, with an accompanying ability to adapt to market change, but at significant cost. At the other extreme, by focusing on a narrowly defined product-market, the organization can focus internally, but with an accompanying risk of failing to adapt when market change occurs.”

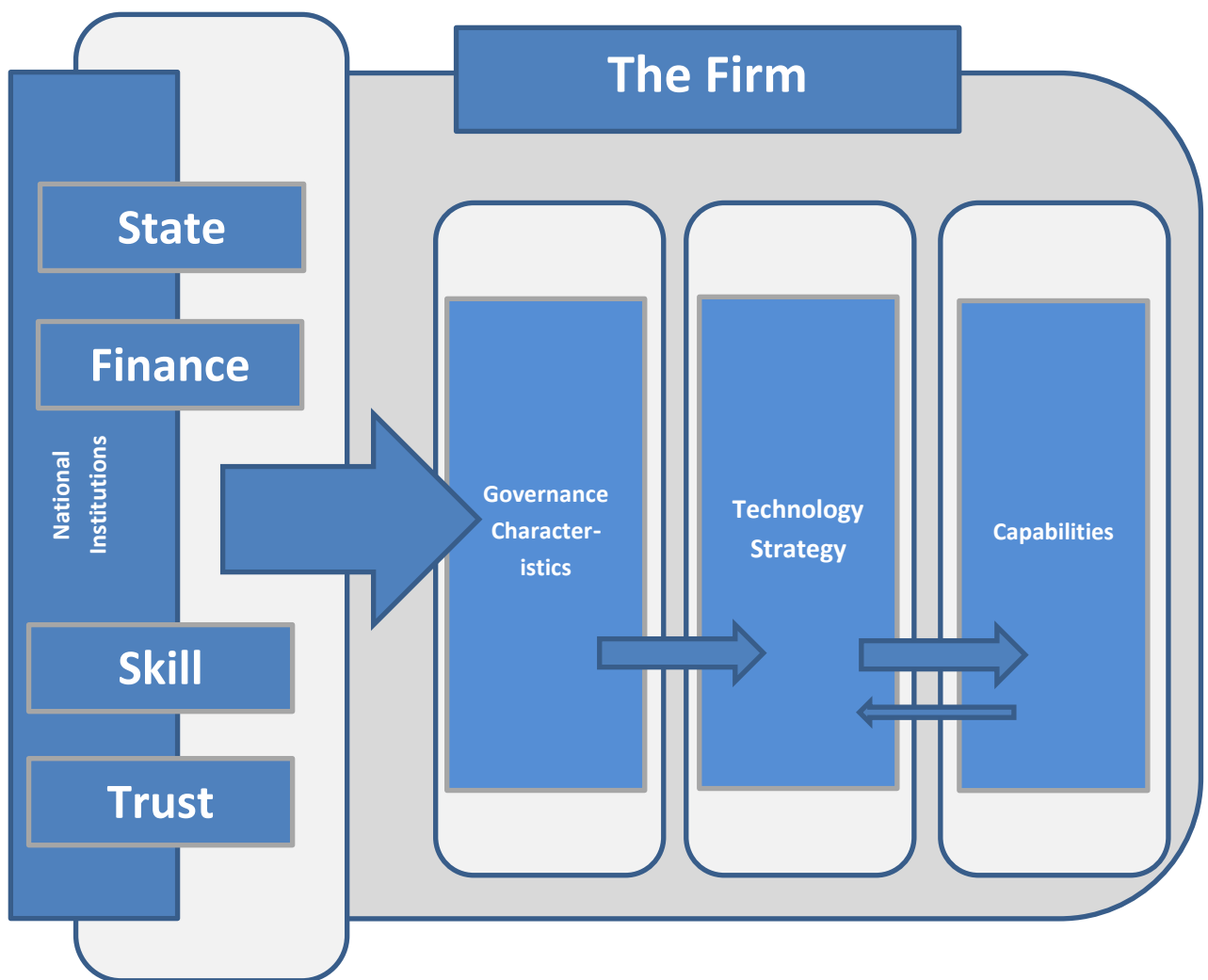
(McKee & Varadarajan, 1989, p. 213)

The above quote directly addresses the problem firms with a Fordist orientation experience when faced with quick changes in the market. Due to the high level of standardisation within their products, these firms are left with only output as a fast tool of adjustment (Tolliday & Zeitlin, 1987). In conclusion, *responsiveness to changing demands and ability to produce differentiated outputs* can be stated as the third and final characteristic of differentiation (Whitley, 1999, p. 74).

2.6 The Ideal Path for Technological Ascent of Developing Firms

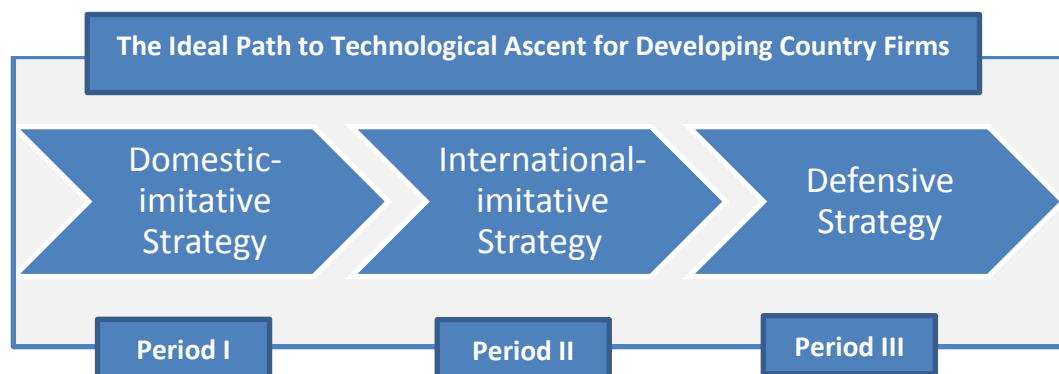
The previous sections of this work have outlined the linkage between national institutions, key characteristics of firms, and technology strategies and their impact on the technological development of developing firms. The purpose of this section is to draw from these previous sections and build a theoretical framework of the ideal path for technological ascent of developing firms by outlining the logical linkage between national institutions, firm characteristics, and successfully implemented technology strategy (Figure 4).

Figure 4: Influencing aspects for the technological ascent of developing firms



It is the national institutions setting the background for the ideal path of technological ascent for developing firms. They link to technological ascent through their influence on the intermediate factors of key firm characteristics and their associated firm characteristics creating distinct national types of firms. In the particular context of a developing economy these ideal firms will be in need for improving their technological capabilities to compete with lead firms on an international or domestic stage. In order to improve their capabilities and close the technological gap, firms are faced with the previously elaborated choice in technology strategies. Drawing from the analysis of technology strategies based on Freeman (1992), there are five key strategies for developing firms to choose from, but the aspect of the development timeline for each individual firm needs to be taken into account. The choice in technology strategy is not a static one but one that is subject to change and reconsideration as the firm develops along the path for technological ascent (Figure 5).

Figure 5: The ideal path to technological ascent for developing country



The ideal path for technological ascent of developing firms takes this dynamic of moving along the development timeline into account and suggests that there is a clear pattern for the optimal advancement of technological capabilities. Based on the preceding review of established frameworks the ideal path for technological ascent would be the following: starting from a domestic-imitative strategy, developing towards an international-imitative one, and finally once the developing firm has matured in its technological capabilities switch to a defensive technology strategy (Figure 5). The choice in path will be further elaborated and justify below.

The starting point for developing firms is the need to advance their technological capabilities to develop beyond a purely opportunistic set up and to become technologically successful. However, it needs to be noted that improving their technological capabilities does not automatically turn a developing firm into a technologically successful one. Following a dependent technology strategy, for example, creates fast results but limits the firm's ability to technologically evolve as they move along their development timeline as the obtained technology will not be unbundled. Hence, the choice of a dependent strategy is not suited to build a technologically successful developing firm. An imitative strategy due to its need for unbundling the obtained technology proves to be more challenging but also yields a higher potential for technological learning and improvement of capabilities. This makes an imitative technology strategy the perfect starting point for the ideal path for technological ascent of developing firms.

Generally speaking, as elaborated earlier in section 2.4 of this chapter the developing firm is faced with two options in imitative technology strategies, firstly the domestic-imitative and secondly the international-imitative one. Of the two strategies at choice, the domestic-imitative one is the more feasible starting point for developing firms to start and improve their technological capabilities. It is more feasible for a developing firm to pursue as there is no need to access foreign technology, but rather the source of technology is a domestic one. This will allow for easier access to technology via poaching experienced employees of the lead firm and partnering with their key domestic supplier for unbundling the obtained technology. All these advantages will help to overcome the initial lack in technological capabilities within the developing firm and enhance the ability of reverse engineering. Further, the technological gap between the lead and developing firm should be narrower and hence be easier to be overcome as in comparison with a more advanced foreign firm. Eventually and to ensure further progress of the firm on the path to successful technological ascent, the developing firm needs to unbundle the obtained technology and utilise it in its own way to be able to overcome the domestic lead firm copied as a source of technology. For this process to be successful reverse engineering is a crucial part, hence the domestic-imitative strategy with its easier access to support for achieving successful reverse engineering is at an advantage. If the firm wants to develop further especially

beyond national borders it will need to, once the step of unbundling the domestic technology is mastered and the firm is matured in its technological development, turn away from domestic sources of technology towards international ones.

Once the developing firms has reached this point in its technological development timeline it is necessary to reconsider changing away from a domestic-imitative to an international-imitative technology strategy. The developing firm will need to take the improvement of technological capabilities to the next level by widening the scope from national to international. Attempting to imitate an international lead firm provides the follower firm with a significant learning potential as the technological gap can be assumed to be greater (Xiao et al, 2010). Further, the access to technology will proof harder to obtain as it will be more challenging for the developing firm to poach key supplies and employees from an international lead firm as opposed to a domestic competitor. Therefore the developing firm will be in need to be able to partly rely on its already obtained technological capabilities through the domestic-imitative technology strategy. Similar to the previous strategy the international-imitative one relies greatly on reverse engineering to unbundle the lead technology. The obtained technology, in a next step, will need to be gradually unbundled and through system integration advanced further for the developing firm to be able to not only close the technological gap to the lead firm but to eventually overcome it. Once this step of technological advancement is mastered, the firm will start to utilise its technological capabilities on its own and become innovative on its own. Should the firms' original innovation proof to be successful the firm will have managed the transition to a technologically successful firm.

This kind of technological success will usually cause the firm being noticed by both foreign lead firms and other follower firms. Lead firms, as a result, will be more reluctant to share any technology with the respective firm as it more and more will be perceived as a potential competitor. While follower firms will start trying to imitate the firm's indigenous technology forcing the firm to react in order to protect its technological capabilities. These developments will result in the developing firm taking the final leap away from an imitative technology strategy towards a defensive one. At this point the firm will protect their own technology and technological capabilities through patents and the reliance on intellectual property rights. Once a defensive

technology strategy has been reached the firm can be seen as technologically matured and successful as it has developed to the point of being in need to protect its technology against both lead and follower firms.

In summary the ideal path for technological ascent of developing firms is starting from a domestic-imitative technology strategy to build an initial set of capabilities to be able to unbundle advanced technology and integrate it into its own set of technological capabilities. Once this step is completed and the developing firm has caught up with the leading domestic firms it is faced with the choice to either stay a domestic player or to expand further and look outside the nation's borders. If the latter option is chosen the developing firm will need to move away from a domestic-imitative to an international-imitative technology strategy and use foreign lead firms as a source for technology. This step is associated with a multitude of challenges as elaborated in the previous sections but once it is overcome the firm can become an original innovator taking from an imitative to a defensive technology strategy. Once the firm has reached point of implementing a defensive technological strategy is can be seen as technologically matured and successful (Figure 5; p.49).

2.7 Chapter Summary

In order to understand the ideal path for technological ascent for developing firms it is essential to understand the correlation between the national institutions creating the background for firm development and the mediating factors impacting the technological success of firms. The theoretical linkage between national institutions, firm characteristics, and technology strategies receives too little consideration in the current research focus. All of these above stated areas are well researched in the respective literature, however mostly only within their contextual boundaries. Whitley in his work has done a substantial contribution in integrating some of these aspects into a wider field of context, especially in regards to the role of national institutions and their influence on firm characteristics (Whitley, 1999). His work has shown a clear correlation between different institutional set ups and their resulting impact on firm characteristics. Yet, to fully understand the development path of late-comer firms in developing economies it is necessary to put these aspects into wider context.

The initial starting point for considerations take place at the macro level looking at the national institutional features as they set the national economical context under which domestic firms operate and develop. Their setup directly impacts the settings under which firms can build their individual characteristics and capabilities and also the external resources available to firms to do so. In the above section a correlation between the external resources influenced by the national institutions and the internal ones a firm is capable of building themselves as a result of it. The key national institutions of influence isolated in the above chapter are the role of the state, the financial system, skill development system, and the trust and authority set up within the national parameters. Hence it is important to understand the specific national institutional context of the country in question. As established within this chapter the key characteristics that firms can develop are dependent on the national institutions and as such cannot be considered in isolation but rather need to be researched in correlation to each other. This in turn means that certain setups of national institutions are more likely to originate specific types of firms with certain characteristics. Further as outlined in section 2.4 of this chapter, the above correlation between institutions and firm characteristics impacts on the choices of technology strategies that a firm can successfully implement for its technological development. As subsequently pointed out

in section 2.6, with the national institutions and the available resources of the firm both being in flux over different periods of time, the available choices of technology strategies for the domestic firm changes as it moves along the path of technological ascent.

In this chapter the study has drawn on different streams of literature and theoretical concepts to develop an initial framework for the ideal path of technological ascent for developing firms. The considerations, at this point in time, have only been of a theoretical nature and are not taken any further into the specific setup of an emerging economy. The following chapter will take these theoretical concepts around the ideal path for technological development into a Chinese context. It is the aim of this research to understand the workings of the ideal path in the Chinese economic reality and not only in its theoretical construction. In order to achieve this, it is important to appreciate the Chinese institutional context to understand the background against which firms operate and develop. Further, the role of mediating factors needs to be considered in the analysis. In the case of China, the national institutional context is not consistent throughout the economy as a whole but differs along the four dimensions of: (i) ownership, (ii) size, (iii) location, and (iv) industry. Taking the mediating factors into account it allows to map out the different types of Chinese firms and to predict for the respective firms' propensity to the ideal path for technological ascent.

3. China Focused Literature Review

The purpose of this China focused literature chapter is to acknowledge and account for the need of analysing the previously elaborated theoretical considerations in a specific Chinese context. China's unique national institutional set up left many of the established theoretical frameworks, based around a predominantly Western perspective, short of explanations. While much research in this field has taken place over the past decades to make up this shortfall it often has been conducted in a rather isolated manner focused on very specific aspects of China and its economic development. The aim of this chapter is to collate the relevant theoretical works around the different aspects of national institutions, Chinese firms, and technology strategies to identify how they impact the technological ascent.

This chapter will start with a brief historical excursion to set the scene for the sections to follow. The transition of China's economy started in 1978 with Deng Xiaoping's opening policy initiating economic reform and China's opening up to the world. The Chinese state has abandoned its historical roots of a centrally planned Leninist economy and has gradually adopted attributes that are more closely associated with a liberal market economy model and yet, China currently still is in transition and does not clearly classify as either a neither coordinated nor liberal market economy (Oi, 1995; Hall and Soskice, 2001). As Oi felicitously summarises China's ongoing economic transition:

"China's post-Mao economy suggests the emergence of yet another form of state-led development that is committed to growth and the market, but it is a developmental party-state with roots in a Leninist system and the Communist Party still at the helm."

(Oi, 1995 , p. 1132)

The shift from planned production towards a production system based on market principles, as well as the degree of political reform accompanying this transition has occurred in rather an evolutionary nature, as opposed to the disruptive transitions by the states of Eastern Europe (McMillan & Naughton, 1992). The economic reform process was a gradual one, leading away from a centrally planned economic regime towards market oriented reforms under the guidance of the central government

(Zhou, 2010). China has taken a distinctive approach in addressing structural changes in the nation's economy through reform initiatives transforming the country.

China's unique path of development has not only created an entirely new form of economic regime but also challenged the existing understanding of the inner workings of national institution systems. Combined with an unparalleled speed and economic success of development, academics have been struggling to understand and explain the transition taking place in China. In such a fast paced environment academics are faced with a dilemma and fall back to what they think to know. Or as Ramo (2004) phrases it; "But it is no wonder that decades-old rhetoric about China makes no sense in a country where two week old maps are out of date." (p.8). If it is any consolation it is not only Western academics struggling to keep pace with developments, but Chinese ones struggle too trying to follow the social and economic changes taking place. However, in the Western world there is a considerable distrust in a successful national economy based on a non-democratic one party state with elements of a market as well as planned economy (Heilmann, 2010; Gehlbach, 2011).

Coming back from this little excursion into the history of China and its perception within the wider field of literature, the following section will provide a brief overview of the chapter and proceed by taking the general literature forward into a Chinese context.

3.1 Purpose of Chapter

The purpose of this chapter is to collate the different streams of China focused literature around national institutions and technology strategies and place it into a wider scope of application in order to identify the ideal path of technological ascent for Chinese firms. The chapter will start by looking at the national institutions in China following the same structural logic as in the previous chapter by elaborating on the role of the state, financial, skill development, and authority and trust system. This will be used to further build the foundation utilised to build the theoretical considerations around the ideal path for technological ascent of Chinese firms.

3.2 National Institutions in China

China's model of economic development is often compared to the ones of Japan, South Korea, and Taiwan. It cannot be denied that that much of its model mirrors key aspects of industrialising economies in Asia. The high rate of savings, substantial

investments in infrastructure, heavy industries and manufacturing, and efforts to steer and stabilise the rapidly growing economy, for example, resemble the policies to be found in Japan, South Korea, and Taiwan followed at similar stages of their development (Whitley, 1992; Woetzel, 2015; Whitley and Zhang, 2016). China until today has an unparalleled pragmatic approach on intervening with market principles, such as been seen in the financial crisis of 2008 and the Chinese stock market crash in 2015 (Whitley and Zhang, 2016). The ability to intervene in such a way into the market is of course reflected in the national institutions which will be discussed in more detail in the below paragraph.

3.2.1 The State

The role of the state within a national business economy can be compared to the one of an adjudicator in a football game. The state shapes the rules under which the individual actors seek their business opportunities within the national institutional context. In the case of China this analogy cannot be that simple. The state without doubt executes the role of an adjudicator through its unchallenged authoritarian influence on key national institutions such as labour and financial market. However in China the state also actively interferes in the role of a major player through its high degree of state ownership (Whitley and Zhang, 2016). Within the landscape of China's economy it can be found in the role of a coach as it has a significant degree of political influence on the appointment and the execution of authority within the management level (Liu and Tylecote, 2016). In some cases the state even carries out the role of a linesman with the final arbitrament over the decision whether or not one of the economic actors has crossed the lines of acceptable business conduct.

Due to the pace of China's ongoing transformation an evaluation of the role of the state according to the criteria developed by Whitley only allows for a temporary glimpse into a still evolving concept even though the degree on institutionalisation has been significantly increased over the last decade and therefore made the development slightly more predictable (Gilley, 2008; Gehlbach & Keefer, 2011). The degree of State dominance within China is considerable due to its extensive presence in different forms within the economy. Regardless of that, the extent of formal regulations within the market is depending on the industry a firm is operating in and can be surprisingly low (Huang, 2003). In his work on institutional innovation

Heilmann (2008) explains this phenomenon, as the following, with the distinct mode of governance by policy experimentation:

“Policy experimentation in this variant constitutes a distinct mode of governance that differs in one fundamental way from standard assumptions about policymaking. The conventional model of the policy process that is widely taken for granted by jurists, economists, and political scientists holds that policy analysis, formulation, and embodiment in legislation precede implementation. Policy experimentation, as presented in this study, means innovating through implementation first, and drafting universal laws and regulations later.”

(Heilmann, 2008, p. 4)

In the case of China, there are two possible strategies that promise the best chances for success in firm development. These are either actively seeking the support and protection by the local, regional or central government to obtain access to markets and the needed level of protection from competition. Or by choosing to avoid the focus of political interest and concentrating on a market of low political interest and using the deliberate political ignorance on it. If the route of political protection is chosen it offers viable solutions to several problems around access issues to capital, market, and labour (Liu and Tylecote, 2016). However, such an access strategy is accompanied by exposing the future firm development not only to high levels of political intervention but also unpredictable changes in the political environment and the resulting possible loss of patronage (Thun, 2006). A market of low political interest is a possibility to avoid political interference on an initial stage of firm development, yet is not a sustainable strategy, as once the firm will reach a certain size and importance it will be impossible to stay ‘below the political radar’. Once this point is reached, it will be impossible to avoid liaising with the respective political authorities to avoid interference with future growth plans. However, if up to this point a certain size and influence could be obtained within the market firms have a significantly better bargaining position as they become too big to fail (Harwit, 2008). Though during the ongoing economic down turn China’s central government has been very vocal about refusing to bail out struggling companies at any price; reality so far has proven a different picture as even if support from a central level is denied, regional or local authorities often jump in to avoid mass job cuts. A recent example can be seen in the

struggling shipyard Rongsheng Heavy Industries (熔盛重工 – Róngshéng Zhònggōng), with shipbuilding being considered a national priority for over a decade now, recent downturns have left the company struggling to survive and now actively seeking help of local governments in their home town of Rugao (如皋 - Rúgāo) and Nantong (南通 – Nántōng) (Wang, 2013).

3.2.2 The Financial System

The financial system within China is in a transitional stage with capital markets developing and emerging in their importance in allocation and generation of capital. However it remains that the corpus of capital allocation is carried out by the state banking system in form of credits. A clear categorization of China's financial system into a market capital or credit based is not possible as the accessibility of capital differs significantly between types of industry and firm (Batjargal & Liu, 2004; Wu & Yue, 2009). In the academic literature it is classified as a state-dominated financial system with its typically associated advantages of addressing market failures and disadvantages of segmentating the internal capital market and mis-allocating capital (Boyreau-Debray & Wei, 2005). This links back to Vitols (2001) argument discussed earlier in section 2.2.2, stating the importance of credit allocation as a powerful political tool to resolve market failures.

China's financial system is generally considered to be lowly developed. While the formal institutionalisation has improved on paper, the final impact in practice is diluted by the high level of decentralization within the Chinese political system where policies often are interpreted with 'regional characteristics' or are ignored completely (Zweig, 1995; Allen & Qian, 2005).

State control on the financial system remains a much used favorite in the central government's economic policy toolkit, whereby financial resources tend to be distributed by political considerations rather than economic necessities. Furthermore, the strong presence of administratively controlled interest rates and strict capital controls not only hinders the emergence of competition within the banking sector, but also limits consumer spending power by keeping interest rates artificially low (Heep & Meissner, 2015). The lack of competition in particular limits the much needed efficient resource allocation amongst firms in China for reasons that will be elaborated further in the section below.

In the case of China, the access to capital from either the banking sector or government institutions varies significantly based on the firm's ownership structure, the industry it is operating within, and its economic importance (Firth et al, 2009). Generally speaking, it can be said that state-owned firms, firms identified as "National Champions", and those operating in pillar industries are subject to preferential treatment when it comes to capital allocation (Thun, 2006). This privileged treatment for SOEs can result in a oversupply of financial resources forstoring inefficiency in certain areas as common governance mechanisms are overruled by state intervention. Further, certain industries tend to be dominated by SOEs not only due to market entry restrictions but also due to SOEs capability to acquire Western technologies regardless of costs (Liu and Tylecote, 2016).

Smaller and less important firms often struggle with capital access and are forced to revert to private capital at significantly higher cost than those able to borrow through banking and government institutions (Chen, 2013). Further, the banking sector and the channels of private capital are rather unregulated and do not offer significant degrees of institutional security. This initial barrier can be overcome by private firms of local importance through soft budget loans issued by local governments as a source of capital. Generally speaking, private firms are often faced with financial constraints, limiting their opportunities to pursue strategic choices as these need to be self-financed.

With the central governments new focus on domestic consumption and an innovation based economy the need for reform within the banking system has been acknowledged by the Chinese Communist Party (CCP). Wide-reaching reforms covering both the banking system and capital markets have been announced to fundamentally rework the Chinese financial system to accommodate the new self-set economic targets. Over the last years, a considerable amount of reform has taken place in China's banking system. For example, the ceiling on deposit rates been relaxed in stages until it has been finally fully abolished in October 2015, as a result the central government as of that date has officially no longer any administrative control on interest rates (Heep & Meissner, 2015). A statement which has to be taken carefully though as the majority of the legal banking sector in China is state controlled there is always the option to take influence through the back door,

so to speak. This does not mean a retreat from the financial system by the state and an end of interference in it. In the same vein has the CCP started to introduced relaxed capital controls, these however have been halted and partly reversed after the stockmarket upheavals of 2015 (Heep & Meissner, 2015).

The fiscal system in China has grown and developed along the years of reforms and often struggled to keep in pace with the changing needs and demands. Leaving China with what essentially is a huge patch-work construct threatening to fall apart under the different forces resulting from conflicts over resource distribution between different levels of government (Heep & Stepan, 2015). Since the 1990s, the financial situation of local governments been problematic and mostly disregarded in the wider discurs on China's development. Events such as the 2008 financial crisis and the resulting gigantic increase in infrastructre investment, of which the local governments had to foot a substantial part of the bill, and China's slowing economic growth has shifted the focus. Attention changed from the central towards the local level after analysists raised the alarm on the increasingly out of control debt structure of China's local goverments (Havilcek, 2016). The income sources of local governments are being rather opaque and mostly revolve around the sale of real estate and land as a source of income. A resource which is particularly hit by the increase of economic insecurity and turndown in economic development, while at the same time expense levels are on the rise. This caused the local debt levels to spiral out of control and threatened the financial stabilty Chinas as a whole (Heep & Stepan, 2015).

The problem has not gone unnoticed by the central government and been addressed in the 13th Five Year Plan. A recent government declaration has just been published in which the Central Committee announced a wide reaching reorganisation of the fiscal system, budget planning and taxation in order to improve the distribution of responsibilities and resources among the different levels of government (Wall Street Journal, 2015). It will remain to be seen if those changes will have the expected and hoped for effects on debt structure of local and regional governments.

3.2.3 The Skill Development System

The matter of access to labour is dominated by two main aspects, namely the access to skilled and well-trained labour on the one side and cheap labour for manufacturing on

the other. While skilled labour is essential to foster innovation, product development, and corporate governance capabilities within the growing organisation, cheap labour is needed in great quantities at low costs to allow for high degrees of low cost manual manufacturing at low levels of automation (Ngai and Chan, 2012). With levels of automation rising and production processes becoming more complex, the requirements for manufacturing labour change as well and focus shifts away from cost to skill of labour (Gallagher, 2015). Labour plays a key part in the implementation of the technological capability strategy within the firm. Skilled labour is needed for the development of any kind of technological capability as well as the respective needed corporate governance structures to manage the associated changes in organisational structure (Freeman, 1992; Liu and Tylecote, 2016). In order to access skilled labour a common strategy is to cooperate with established research institutions and universities to recruit talented people.

It can be argued, that the Chinese educational system, foremost the early years of intense and repetitive learning of characters, values learning by heart over critical analysis and creativity (Woetzel, 2015). This argument however will not stand up in later years of education at leading Chinese universities, as these have over the years through international cooperation and returning Chinese academics from abroad, changed their approach on teaching significantly (Klorer, 2015). And such companies, like e-commerce giant Alibaba and Apple rival Xiaomi, who have innovation at their heart of success seem to be proof for this. These firms would not be able to flourish in the way they do, if the staggering numbers of Chinese university graduates would live up to the above false perception.

In China labour relations are in need to overcome deep rooted loyalty issues and low levels of commitment within the employer-employee relations. Generally speaking, skilled workers are in high demand and follow the money leaving smaller and less established firms struggling to attract the needed talent (Friedman and Lee, 2010; Gallagher, 2015), while cheap labour workers are often migrant workers without any form of residence permit for the respective area and therefore limited degrees of commitment to their employer (Chan and Ngai, 2010). This difference in labour loyalty and commitment becomes apparent in the different governance structures of civilly originated SOEs and military based SOEs. While civil SOEs often struggle with these

problems of loyalty and commitment within their workforce, military based SOEs can overcome such issues. Due to their military heritage and often high numbers of former military staff amongst their employees, workers often consider their jobs as a patriotic duty and exhibit high levels of commitment to their role and employer (Xiao & Tylecote, 2013).

Over the last decades of reforms, severe changes were implemented but not necessarily executed throughout the political levels (Chan, 2000; Schucher, 2006; Bass, 2007). The public training system is strongly state dominated and just recently with the 11th Five-Year Plan in 2006 moved the focus of the political agenda with the aim to implement a public training system with a close orientation to the German dual system (Rauner, 2009). The national institutions in skill formation up to this point had not been particularly formalised and personal connections had been more important than individual skills for the allocation of personnel. However, this is bound to change as China seeks the transition to a more standardised public training system (Harbrecht, 2010). It is intended to build up a triennial vocational training program with the first two years focusing on general education and impart profession related expertise followed by a one year practical component in form of an internship within the relating industry (Harbrecht, 2010).

The “Made in China 2025” strategy promoted by the central government, aiming at transforming China from its current state into an innovation-driven industrial nation, puts further pressure onto the set up skill development systems in China (Kennedy, 2015). For this strategy to be more than an unworkable idea in the party’s propaganda, Chinese firms will need access to a highly qualified workforce to shift away from low-end manufacturing. Currently the system of vocational training is not able to create the levels of skilled labourer needed within many industrial sectors and skill shortages are experienced as a result. The training and labour market does struggle to adapt to the changing needs of the Chinese firm. Further, vocational training has a very low social perception in the wider Chinese society and most young adults will try to move towards a university education (Klorer & Stepan, 2015). This is resulting in market demand and supply not being aligned. University graduates struggle to find appropriate jobs, while skilled vocational industry jobs cannot be filled with suitable candidates. The mobility between university studies

and higher vocational training will need to be improved in order for this kind of candidate to become more widely available. In order for this to be achieved there will be the need for a coordinated and committed approach by both state and firms in China to create such training opportunity.

As far as trade and labour unions are considered, the consistent problem of implementation once more needs to be looked upon. The current situation of labour unions is based on the March 21st, 2006, released draft for the new labour contract law (中华人民共和国劳动合同法 – Zhōnghuá Rénmín Gònghéguó Láodòng Hétong Fǎ), which secures labour unions a considerable degree of participation rights. Yet, in reality many of the unions in China do not execute these rights (Schucher, 2006). Many scholars argue that the reluctance to meet their obligation is rooted in the double identity of the All-China Federation of Trade Unions (ACFTU) as a close interlinked part of the state machinery and the resulting conflict of interests to consequently fight for labourers' interests (Grassi, 2008). In summary, it can be stated that China does not have independent trade and labour unions as it is perceived by Western definitions. As previously discussed in chapter 2.2.3 in the general literature review of this research, it is important to acknowledge this shortfall in Western definitions as far as Chinese unions are concerned. In China, unions function less as the guardians of workers' rights for which they fight if these are endangered but rather are being understood as a welfare provider in the cases where state support falls short.

Regardless of the setbacks in the implementation there is a general trend away from an unregulated labour system governed by market forces to a more coordinated version of skill development and control (Braun, 2006; Grassi, 2008).

3.2.4 The Authority and Trust System

In the literature, authority and trust systems are analysed along three different key relations: (i) reliability of formal institutions governing trust relations, (ii) predominance of paternalist authority relations, and finally (iii) importance of communal norms governing authority relations (Krug, 2004). A consistent degree of discrepancy between formal regulations and the lack of implication leads to a consequent low level of trust into formal institutions as opposed to the considerable

influence of paternalist authority relations and the high degree of communal norms within the Chinese society (Whitley, 1992).

Attempts have been made to measure this lack of trust in formal institutions in a quantitative way and it has turned out to be hard to prove in a numerical manner and yet scholars consequently speak of low trust in formal institutions for China (Shi, 2001; Warner, 2002). As far as paternalist authority is concerned, Tao concludes in her work that the roots of this kind of authority systems lie with the Confucian heritage of Chinese society:

“Confucian account of trust emphasizes paternalistic trust, procedural trust and moralistic trust, with moralistic as foundational to the other notions of trust. Moralistic trust is not something one can generate from rule and institutions, [...]. Neither can it be called into existence by command of authority.”

(Tao, 2008, p. 86)

The answer for the low degree of institutional trust can be found within this quote, as Tao argues that trust cannot be generated through rules and institutions nor instantly created through authority. Hence, it is common in China to place more trust into personal relations of the extended family than into any formal institutions which are substantially rooted in the traditional Chinese social system (Heilmann, 2008). The concept of extended family in this context is not to be confused with the sociological one. Trust often is placed into tightly knit family like organisations, such as university alumni, trade organisations, regional identity groups, or even inner departmental teams, which are hard to penetrate for people outside these accepted circles (Kuhn, 2001; Heilmann, 2008).

The legal system can be seen as a good indicator for the state of the Chinese authority and trust system. China's legal system has, from its early stages on, been plagued by low levels of institutionalisation and limited trust placed into it by the wider Chinese society. It is common for legal proceedings to be drawn out and accounts of forced confessions, arbitrary rulings, and political interference are known to be a daily occurrence in the Chinese legal system (Stepan, 2015; Heilmann & Rudolf, 2014). The issue of needed reform has been a long-standing one, but the

central government did not pay much attention until numerous cases of food and environmental pollution scandals caused growing discontentment amongst the Chinese population (Wübbeke, 2014). In 2013 the issue of judicial reform was firstly vocalised by Xi Jinping and further been discussed by party leadership during the Fourth Plenary Session in October 2014 (Stepan, 2015).

Following Deng Xiaoping's motto "crossing the river by feeling the stones", the reforms were rolled out as an experiment on a trial basis in various cities in China, including Shanghai and Shenzhen. Strengthening the rule of law is a focal point of the intended reform, however one should not get carried away in the assumption this would also promote a separation of judiciary and central government. This is not the case and the Western principle of separation of powers was categorically rejected by the Chinese Supreme People's Court (Stepan, 2015). The political supervision of court system, judges, and rulings will remain with the party's Central Political and Legal Affairs Commission (政法委员会 – Zhèngfǎ Wěiyuánhùi) effectively leaving the previous power balance within the judicial system untouched (Heilmann & Rudolf, 2014).

"Under Xi's leadership, the CCP has extended its control over virtually every single economic and social sphere. The party keeping control over the judiciary, intensified supervision of social groups, and massive expansion of internet surveillance already conflict with the societal interest to a large extent." (Stepan, 2015, p.8)

The issues of political interference and the overall weak position of lawyers are persistent problems of the Chinese judicial system even after the reforms and they will limit the gains in trust that can be generated.

3.3 Characteristics of Chinese Firms

This section aims to discuss key features that influence the characteristics of Chinese domestic firms. The section will look at the following four aspects: (i) ownership, (ii) size, (iii) geographic location, and (iv) industry.

Ownership

A commonly used starting point to understand and differentiate Chinese domestic firms is their ownership structure. Table six (adapted from Whitley; 1999) gives an overview of the different ownership types of Chinese domestic firms. The main differentiation is state-owned and private-owned firms, with state-owned being further divided into majority and minority state-owned (Table 6).

Figure 6: Ownership Structure Chinese Domestic Firms

Firm type	Domestic firms		
Ownership type	State-owned		Private-owned
	Majority-state owned	Minority-state owned	
<u>Governance</u>			
Management Selection	Selected by State	Selected by Shareholders	Selected by Shareholders
Management Control Type	Policy Constrained	ROI Constrained	Owner
Employee-interest Constraints	Low	Some	Low
Business-partner Constraints	Variable	Low	Low
Dominant Goals	Growth & Stability	Growth & Investor Returns	Wealth
<u>Capabilities</u>			
Employee Contribution	Low	Limited	Limited
Innovation Focus	Low	Variable	Limited
Responsiveness Focus	Low	Variable	High

The question of origin of ownership creates a first basis of differentiation as both state-owned and private-owned firms in the end do share the same set of institutional

features once they start operating within the domestic market. However, the set of rules given to them by these institutions to participate in the game differ significantly.

In a second step, the group of state owned enterprises will further be subdivided into *majority* and *minority state-owned* in order to allow for a clearer differentiation between the two forms of ownership within this group. The second axis of differentiation is rooted in the governance structure of the firm, essentially in the way the management is selected and controlled through the shareholders. The category of management selection will be partitioned into *selected by state* and *selected by shareholder* as this is closely related to the method of control implemented by owners over management autonomy and therefore having a direct influence on the strategic decisions of firms.

The State Owned Enterprise

Beginning with the detailed analysis of the dominant types of firms with Chinese characteristics on the level of domestic ownership, the initial focus will turn towards the state-owned enterprises and their characteristic set of features.

Within the *majority state owned enterprises* it is common that the management selection is carried out by the state as the main shareholder, in the Chinese case this happens in the form of state officials that are parachuted into the company's management (Walder, 1995; Wong & Slater, 2002). This particular incorporation of the official's career path into the one of a manager leads to a very distinct characteristic in managerial strategy as managers are relocated into different positions on a rotational basis causing a considerable short term alignment within their managerial focus. With the appointed manager being controlled and held accountable by their superior their decisions are highly constrained by the political agenda of the state as they would jeopardize their future political and managerial career by opposing direct orders from their superior. Therefore, it is of crucial importance for this type of manager to maintain a favourable stance with the state authorities to ensure any future career development. The general short term approach on strategy and the need for good relations with state authorities lead to a limitation of resources and interest towards the involvement of employers and business partners into strategic decisions as they are dominated by state goals. In the case of business partner constraints the

behavioural pattern within SOEs has gradually changed over the last decade as with the proceeding market reforms the sense of competition arose and SOEs started to struggle for state support and approval (Cull & Xu, 2003). This new found competition replaced the earlier 'brothers in arms' mentality where competition between SOEs was nearly absent and information and knowledge was commonly shared with competitors through the industry. The overall goals within the majority state owned enterprise are divided into a socio-political level and a more commercially motivated one, whereby the more commercial one is grounded in the career ambitions of the official manager to generate growth in order to allow for a promotion within the proceeding rotational work placement. The socio-political goal of majority state owned enterprises is rooted in the Maoist legacy of SOEs as they are used as a tool to maintain harmony within the society by providing work and income for a vast number of people which in turn is part of the strategy to fight the crisis of legitimacy within the Chinese Communist Party (White, 1986; Zhong, 1996; Chen, 1997). When it comes to the specific capabilities for this particular kind of firm the undetermined strategic orientation causes the firm to be stuck between a rock and a hard place. As the short term focus in strategy and lack of employee contribution prevent them from building up the needed accumulation of knowledge within the labour force and yet the organisational complexity of its operations avoids the enterprise from the establishment of a focus on responsiveness. The ongoing respectable success of SOEs to some considerable extent is constituted in its crucial importance for the ruling elite in order to legitimate their authority and to actively influence and govern the economic development of the Chinese national business economy. And yet this exact kind of state support causes a lack in incentives for SOEs to build up much needed internal capabilities as the state support and preferential treatment isolates them from the market forces encouraging such a development.

In the *minority state owned enterprises* the overall situation presents itself in a different kind of light as the firm characteristics differ significantly from those of the majority state owned ones (Nolan, 2012). As the management selection process in this typology of firm is executed through the shareholders and not as in the former through state directive, the subsequent type of control implemented therefore is revolving around return on investment (ROI). With different shareholders being the

dominant representation of owners within a firm, ROI often is chosen as the grounds based on which managers are held accountable and consequently shape their decision patterns in terms of firm strategy. In logical coherence with this method of accountability, the dominant goals are ROI and, dependent on the degree of shareholder inclusion into the internal procedure of the firm, the main aims can be found in overall growth. Due to the fierce competition over external funding the degree of business partner collaboration is rather low within this type of firms as opposed to financially less constrained majority owned state enterprises.

The degree of employee's interest constraints are dependent on the strategic focus chosen by the firm, and so does a focus on innovation that often adheres a certain degree of dependence on the employee's skill set to generate the internal capabilities needed. Within this mentioned employee contribution it is necessary to differentiate between the strong authoritarian discrepancy between blue and white collar workers, as well as between high and low skill levels of workers. Generally speaking, if employee contribution takes place, it normally only incorporates higher levels of hierarchy within the firm and is not omnipresent on the shop floor level. As already briefly mentioned earlier, the either innovation or responsiveness focus within the firms general alignment is rooted in its overall strategy and the degree of shareholder inclusion, as the consequent pursuance of an innovation focus is contradicting with the dominant goal of ROI and in need of an educated shareholder with a long term horizon.

The Private Owned Enterprise

The firm type of private owned enterprises has been emerging in increased numbers since the opening and reform policy was established in China. In terms of management selection it follows a shareholder approach accompanied by the direct owner control over the management. In China private owned enterprises are often owner-led and there is a certain convergence between shareholder and owner as they are, if not one and the same person, often do have close personal ties to each other (Whitley, 1992). In terms of employee constraints these are considered to be low as the firm mostly is run in a paternalistic authorial way and employer-employee relations are governed by rule of authority. Within the field of business partner constraints, the lack of reliance in formal institutions causes the level of trust between different economic actors to be rather low and therefore, keeping the degree of business partner constraints low as

well. The dominant goal within the firm's strategy often is characterized by the pursuit to generate wealth and increase family reputation. This of course is a generalization that calls for relativisation as private owned firms within China grow and reach different levels of maturity causing the overall goals to evolve with the changing circumstances, so it can be argued that entrepreneurs are willing to sacrifice short term profits and do invest into long term future opportunities. This particular set of characteristics does in return influence the likeliness for certain capabilities to be fostered to emerge within the firm. The degree of employee contribution often can be found to be rather low as the strong decisional dominance of the owner leaves only little room for codetermination or integration of employees into the process of strategic decision making. Private owned firms often face severe capital constraints which are worsen by an underdeveloped financial system and limited accessibility to externally funded capital. With the private owned firms often facing severe capital constraints which are worsen by an underdeveloped financial system and limited accessibility to externally funded capital. This often leaves privately owned firms in a precarious financial situation, limiting the possibility and willingness to bind capital into future investments that do not generate immediate profits and therefore, limiting the feasibility for these firms to pursue an innovation focused strategy. A focus on responsiveness is much more plausible to evolve as these firms, due to their low degree of constraints, are rather flexible towards market changes and can adjust to these within short term.

Size

Size as such is not necessarily classified as a firm characteristic. However, it does directly impact on them and hence should be taken in consideration. This consideration is not a specific to China but rather generally applicable. A variety of literature can be found around the direct link between size and a various firm characteristics, such as management control, employee contribution, and the nature of innovation (Cohan & Klepper, 1996; Kim & Brunie, 2002; Vaona & Pianta, 2008). The general consensus is that, generally speaking, the larger the size of a firm the less susceptible it is to adverse external environment. China is no different from this general observation. In particular in regards to innovation, size as a factor, has been given considerable attention within the literature (Cohen & Klepper, 1996; Beck et al.,

2005; Du & Girma, 2012; Lee et al., 2013). Further in the particular case of China, it is useful to discern between domestic firms of different sizes in conjunction with ownership structures. They are (i) small/medium SOEs, (ii) large SOEs, (iii) small/medium POEs, and (iv) large POEs.

Industry

The differentiations between strategic and non-strategic industries in China is a fluid differentiation, dependent on the economic and political targets of the central government and are usually communicated through their Five Year Plan (Harwit, 2008; Nolan, 2012). Once an industry is classified as strategic, they are closely monitored and regulated by the central government. Their political and economic importance is reflected in the frequency of industry policy papers published, such as the automotive industry, which has been subject to three major industry papers over the last ten years (Liu & Tylecote, 2016).

Private owned enterprises are rarely represented in politically significant pillar industries as they are often a stronghold of the SOEs causing private owned enterprises to disperse into less strictly monitored and regulated market segments (Meissner, 2015).

Location

Chinese economic development has been impressive; however it has not been one of equal geographical distribution. Most economic activities are focused along the coastal regions and the designated 'special economic zones': in particular Shenzhen, Shanghai, and North Tianjin (Heilmann, 2008). There is a considerable discrepancy in economic development between tier one and tier two or three cities, which is reflected in the level of attention and support those cities enjoy from central government (Xiao et al., 2013; Woetzel, 2015).

Further, there is an important difference in institutional governance between coastal regions closer to the central government and more remote inland locations that experience less control. As Hurst (2013) describes it: *"The Chinese state is notorious fractious and difficult to control at its lower levels. In its continuing efforts to discipline far-flung agents the centre paid increasing attention to administrative law and*

litigation since the mid-1990s.” However these efforts to extend central government control have yet to prove completely effective and these variances create important implications associated to the location of Chinese firms.

3.4 Technology Strategies in China

Late-comer firms in China are essentially faced with the choice of the five different approaches on technology strategy as elaborated in detail in section 2.4 of the earlier general literature review. The following analysis will take the theoretical concepts of Freeman (1992) out of their general perspective and analyse them with a focus on China in mind. The section will start by discussing the different technology strategies that have been discussed from a theoretical point of view and place them in a specific Chinese context (Table 3 and 4). In a first step, the five different strategies will be presented in light of the viability in China, while in a second step the focus will shift towards the Chinese firms and the availability of the needed external and internal resources to implement any of these strategies.

The Dependent Technology Strategy

The dependent technology strategy is considered to be the one least in ambition. This is founded in its low requirements posed against the needs for unbundling of technology required by the firm pursuing such a strategy. However, a dependent strategy is not a bad choice to initially access foreign technology and gain production experience in order to switch to an international-imitative strategy at a later stage of development, as has been the case in South Korea for many of the chaebol firms (Whitley, 1992; Xiao et al., 2013). The significant difference in requirements to successfully pursue an imitative strategy instead of a dependent one should not be underestimated. Especially in the Chinese economic context in which the choice of a dependent technology strategy is much more appealing to state-owned enterprises as opposed to the international-imitative one usually associated with privately-owned firms (Liu and Tylecote, 2016).

The dependent strategy has proven to be very popular in China as a warrant to achieve static capabilities quickly generating fast and high visible results on the conducted investment (Tylecote, 2014). This proves to be of particular interest to state-owned firms which are characterised by managerial objectives that are driven by short-term

results as the tenure of the respective manager usually is fixed term and fast and visible results are needed for career advancement (Liu, 2009). Further, state-owned firms have beneficial access to financial resources allowing them to enter into comparatively expensive agreements for technology licensing with foreign firms (Thun, 2006). This often is a limiting factor for privately-owned Chinese firms as they lack the access to financial resources of this scale to fund licensing agreements (Firth, 2009; Chen, 2013). In return for the received payments the lead firm will provide the Chinese firm with all the needed technology, production facilities, and components to start production of a comparatively advanced product. This will result in a fast increase of market share to be gained and profit to be generated by the firm pursuing this strategic choice as they can quickly outpace their domestic competition (Liu & Tylecote, 2016). On the other side, the respective firm is getting into a dependent relation with the foreign frontier firm and is not required to unbundle any technology limiting their possibility and motivation for any knowledge to be absorbed. This will limit the ability of the Chinese firm to autonomously advance its technological capabilities and to develop competitive products without the support of the foreign partner. This is exemplified by the Chinese automotive sector which is dominated by well-funded Chinese state-owned firms with access to Western technology through their respective joint-venture partners. One of the longstanding SOEs in the Chinese auto industry is Shanghai Automotive Industry Corporation, short SAIC (上海汽车工业总公司 – Shánghǎi Qìchē Gōngyè Zǒnggōngsī) and it illustrates the firm characteristics of a state-owned enterprise to a considerable extent. It has longstanding commitments to both Volkswagen and General Motors in established joint ventures that are intended to generate capabilities for SAIC to build up an own product range (Gallagher K. S., 2006a). Regardless of the exposure to foreign joint venture partners, SAIC still is struggling to build up an own product range (Chen & Kokko, 2011). Up to today the majority of knowledge and technology used to build up SAIC's own brand Roewe (荣威汽车 – Róngwēi Qìchē) has been acquired through mergers and acquisitions and not been internally generated. The current models offered by Roewe do mostly base on the technology of Rover which SAIC and Nanjing Automobile Corporation (南京汽车集团有限公司 – Nánjīng Qìchē Jítuán Yǒuxiàngōngsī) gained access to in 2005 (Focus

Money, 2005). None of these automotive SOE firms have so far managed to develop a stance outside of China or export cars in significant numbers.

In summary, the dependent strategy is very effective in quickly accessing foreign technology and in advancing product quality and technological product features. However, the limited levels of learning associated with this particular technology strategy only allows for very little technology to be absorbed by the Chinese firm, while most of the technological capabilities remain with the foreign partner firm.

Domestic-imitative Technology Strategy

The domestic-imitative strategy is seen as less ambitious in their efforts required by the late-comer firm and is often associated with early stages of the catch-up period within a developing economy (Luo and Wang, 2012; Liu and Tylecote, 2016). This is rooted in the understanding that it is easier for a firm to seek access to technology or poach former employees of a leading national firm in its own country of origin as opposed to venturing abroad. Also, the knowledge gap between a domestic late-comer firm and a domestic leading technology firm is assumed to be less significant as they are from an international viewpoint both late-comer firms. In comparison, the international-imitative strategy would require much greater efforts to be made by the Chinese late-comer firm to imitate the foreign frontier firm successfully.

Generally speaking, the underlying requirements for both imitative strategies to be successful are similar. The main corporate governance requirements are: (i) an engaged management with a long-term orientation and a vision to improve the technological capabilities of the firm, and (ii) highly levels of commitment and initiative amongst the employees (Xiao et al., 2013). This, as elaborated in the earlier chapter on Chinese firm types, is more likely to be the case in private-owned firms than state-owned ones. Further, for the strategy to be successful it is inevitable that the firm is operating in a restricted competitive environment as a firm pursuing a domestic-imitative strategy could not compete with any technologically advanced firms (Tylecote, 2014). This is mostly rooted in the limited potential for learning as the Chinese firm is following a domestic firm for technological catch up. To make this argument more explicit, if a firm following a domestic-imitative strategy is faced with direct competition of Chinese firms following either a dependent or international-

imitative strategy, it will not have the needed foreign technology and quality standards to compete besides a possible low-end segment of the market (Luo and Wang, 2012).

In summary, the domestic-imitative strategy is commonly associated with very early stages of technological catch-up of late-comer firms in developing economies. In a far along developed economy like China a domestic-imitative strategy does not provide enough competitive advantage to succeed in the long-term due to the high levels of both domestic and international competition in most industry sectors, but it forms an ideal initial starting point for technological ascent. The advantage for choosing a domestic-imitative technology strategy lies in the chance for the developing firm to close the technology gap between itself and the domestic lead firm. In a second instance, this choice proves beneficial for Chinese developing firms should they decide to take on the domestic lead firm by switching its technology strategy to an international-imitative one.

The International-imitative Technology Strategy

The international-imitative strategy is the second type of technology strategy based in imitation available to Chinese late-comer firms. In the literature the international-imitative strategy is regarded as superior over the domestic-imitative one as it creates greater dynamic capabilities (Liu & Tylecote, 2009). It is perceived as being superior as the source of technology to be imitated by the Chinese firm is closer to the technological frontier than compared to the domestic-imitative strategy. This technology, as previously stated, can either be obtained by reverse engineering, poaching employees, and obtaining access to the lead firms' network of suppliers. Poaching employees would prove difficult for Chinese firms due to the significant cultural differences and the assumed geographic distance between lead and imitating firm. This is especially the case for Chinese firms based in more remote areas, as they will be less attractive to foreign employees compared to firms based in more developed costal area. Similarly, accessing the foreign supply network will be comparatively difficult due its geographical distance.

The requirements for a Chinese firm to be successful in the pursuance of an international-imitative technology strategy are in theory identical with the ones of the dependent strategy. They both require long-term engaged management control

combined with a committed workforce in regards to firm characteristics and limited levels of competition from both domestic firms following a dependent strategy and foreign firms to allow for learning by doing. In reality, due to the greater knowledge gap between the Chinese domestic firm and the foreign lead firm the learning process would prove to be more challenging and calling for a longer period of catch-up in which the firm would need to be protected from such competition (Xiao et al., 2013). China's geographical size and high levels of regional differences can create a temporary isolation from competition allowing firms to pursue learning by doing and gain market share in a protected market environment. Only recently have foreign firms started to move away from the more developed coastal areas and started targeting the less developed rural ones leaving them open to domestic firms to develop their capabilities. For example, Western brands Nike and Adidas are solely focused on tier one cities in China, while Chinese brand Li-Ning Sports does mostly target tier three cities and generates 97 per cent of its sales in China (Czinkota & Ronkainen, 2007). More remote areas also serve as incubators for Chinese firms before they are expanding into larger markets with domestic firms being skilled at identifying space in the market, learning and adapting as they go along.

The advantages for Chinese firms following an international-imitative strategy are the limited financial resources required to pursue it and the greater potential for technological learning. The first point is particular appealing to privately owned Chinese firms as they are at disadvantage to access capital through the financial markets making a dependent strategy often financially not viable (Thun, 2006). The second one is of great significance at a later stage of development as it will ease the transition away from an imitative towards a defensive strategy. Both imitation and innovation are acknowledged drivers for technological advancement (Park, 2008). An imitative strategy is an ideal stepping stone for late-comer firms as with increased access to global advanced technology, more sophisticated customers, and suppliers, these firms will be in a position to develop their own innovations based on their technological capabilities learned (Mahmooda & Singh, 2003). Using the Chinese automobile industry as an example again, Geely Holding Group (吉利控股集团– Jíli Kònggǔ Jítuán), under its CEO Li Shufu (李书福), managed to build up a strong foothold in the industry and accounted for a domestic market share of 3.6 per cent in 2009 (IHS

Global Insight, 2011). Geely made itself known on the world stage of automobile manufacturers with its unexpected but successful reach to buy the struggling Swedish car manufacturer Volvo in August 2010 further illustrating the high ambitions of the company (Li, 2010).

In summary, the international-imitative strategy is comparatively challenging for Chinese firms at early stages to be successful but does offer greater scope for learning in regards to technological capabilities. It appears that imitative strategies are much more widely adopted than innovative ones amongst Chinese firms. For the time being, Chinese firms can rely on their imitative skills and cost advantages to maintain competitive, however in the long run they will eventually need to break the imitation cycle as their cost advantage erodes (Xie, 2006; Kriz, 2010; Zheng, 2012). Having followed an imitative strategy will be beneficial at later stages of technological development to the follower firm once it has matured. Due to the need for unbundling the obtained technology and the resulting greater scope for learning, developing firms following an imitative strategy will be better suited to cope with the challenges associated with the changes from an imitative to a defensive technology strategy (Freeman, 1992; Xiao et al, 2013; Liu and Tylecote, 2016).

The Defensive Technology Strategy

The defensive strategy is the first step away from a dependent to an active approach on technology. Any firm pursuing a defensive strategy is developing its own genuinely new technology through R&D and will usually try to protect its innovation through patents (Xiao et al, 2013). The defensive firm will try to protect its technology from firms following an imitative strategy based in developing economies and from firms with an offensive strategy threaten their established technology through breaking innovations.

In the case of China, the discussion is still revolving around the question of Chinese firms genuinely having achieved substantial technological capabilities, or whether they still imitate foreign technology (Cheung and Lin, 2004; Altenburg, 2009; Zheng, 2012). The minimal effort approach on a defensive strategy is to invent around existing technology, meaning that the late-comer firm identifies what the current frontier technology does and re-invent it in a slightly different way, which allows them to gain

patent protection for their deviation of the technology (Liu et al., 2015). This approach can also include the production process and can lead to opportunities for further improvements in the fields of production engineering. A strong defensive strategy however will be grounded in a strong patent base of the firm that will allow the firm to cross licence with other firms. This phase of inventing around can be considered a transitional stage between an imitative and a defensive technology strategy. Technology advances by both innovation and imitation, however there are limitations to how far imitation can advance the existing technological skills (Park, 2008).

As stated in the previous part of this work, the late-comer firm is expected to move away from an imitative strategy towards a defensive one as its development continues and it is starting to be faced with more resistance from foreign firms and limitations on imitation through increased IPR constraints. IPR plays a significant role in the firms' transition from imitative to defensive technology strategies as it highly affects the firms' willingness to commit to and profit from innovation (Teece, 1986). Not only do Chinese firms have a growing interest in improved IPR protection as they mature in their technological capabilities, but also foreign firms will push for a stronger enforcement once the matured firms are perceived as a threat. For China the theoretical turning point on IPR was its joining of the World Trade Organisation (WTO) in 2001, at which point the levels of IPR protection improved significantly on paper (Hu, 2008). The real life impact of the newly improved levels of IPR protection has only gradually developed over the years. Regardless, they have made an imitative strategy, especially for firms at a later stage of development, less attractive as technology is more closely protected. The changes in IPR protection levels in turn resulted in a change in resource distribution between imitative and innovative activities (Keller, 2004).

In order to build a strong defensive technology strategy, the respective firm needs to have a highly developed and well directed approach on R&D which requires not only substantial and stable financial resources but also the needed capabilities to put the capital to use. Xie (2006) isolated several main issues common to all Chinese firms transitioning from imitative to defensive strategies: (i) managing the shift in organisational identity, (ii) introducing appropriate management systems, (iii) improved investment decision processes, (iv) improved HR processes, and (v) seeing

collaboration and communication as fundamental strategic issues. It is the change in paradigm of organisational identity that calls for a change in management systems and informal organisational processes. So would a firm need to be able to engage their workforce to generate levels of commitment to achieve an increase in technological capabilities, which in turn would need to be reflected in the managerial system in place. Due to these requirements the outlook in future potential to enhance its technological capabilities are significantly higher than compared to the previous dependent or imitative strategic approaches (Xiao et al., 2013). Based on the expected pre-requisites to be found in a dependent or an imitative firm respectively, it can be assumed that firms following an imitative technology strategy will be faced with the easier transition.

The last and most ambitious approach on technological strategy is the offensive strategy. It is characterised by firms that strive to be the leaders in new products and technology within their industry. These products are developed based on own R&D work and due to the highly innovative nature of the products often in close linkage to the respective science base (Liu et al., 2016). A firm following a successful offensive strategy is actively advancing and contributing to the technological frontier on an international level. In order to do so, firms are required to have a strong internal R&D department which is closely linked to innovative research close to the technological boarder through the science base and leading firms in the field. Further, it becomes crucial to have very close links in respects to R&D to related sectors of relevance in the industry and lead customers and suppliers to understand the needs of the industry and be able to generate ground breaking innovation (Xiao et al., 2013). In the case of China, the wider architecture of the innovations systems needs to be considered. Until 2000, there was hardly any patent activity coming out of China with an IPR protection system which was close to non-existent (Hu, 2008). Firms following an offensive technology strategy are highly dependent on close cooperation with the science base. If the respective science base is under developed in the firm's home nation, it will prove harder for the firm to access the needed technologies to develop disruptive innovation. Firms operating under an offensive strategy are at the forefront of technology and have high levels of capabilities which are usually out of reach to late-comer firms. Hence, an offensive strategy is normally not of interest for late-comer

firms in developing economies and is stated here for the sake of completeness rather than for further analysis.

3.5 The Chinese Ideal Path for Technological Ascent

Section 3.2 elaborated on how the Chinese national institutional environment impacts the domestic firms and their capabilities. In section 3.3 the characteristics of Chinese firms are presented, while in section 3.4 the different technological strategies within a Chinese context available to developing firms were discussed. Further, the likelihood for long term technologically successful development of the respective firm was evaluated. The purpose of this section is to draw upon the previous considerations in the theoretical development of an ideal path for technological ascent in China.

Previously within this work based on a wider theoretical analysis of the general literature, a generic ideal path for technological development has been identified, which is discussed in detail in section 2.6 of this work. In the context of China two possible ideal paths to technological ascent for developing firms emerged (Figure 7). Option I starts following a dependent strategy which the firm continues to pursue throughout the second period of development until it eventually matures and chooses a defensive strategy. This strategy however seems to be less successful, as most firms starting on a dependent strategy tend to continue on this strategy and do not achieve the step from dependent to defensive technology strategy. Option II outlined below is the path with a higher probability to lead to technological success and will be referred to as ideal path to technological ascent moving forward.

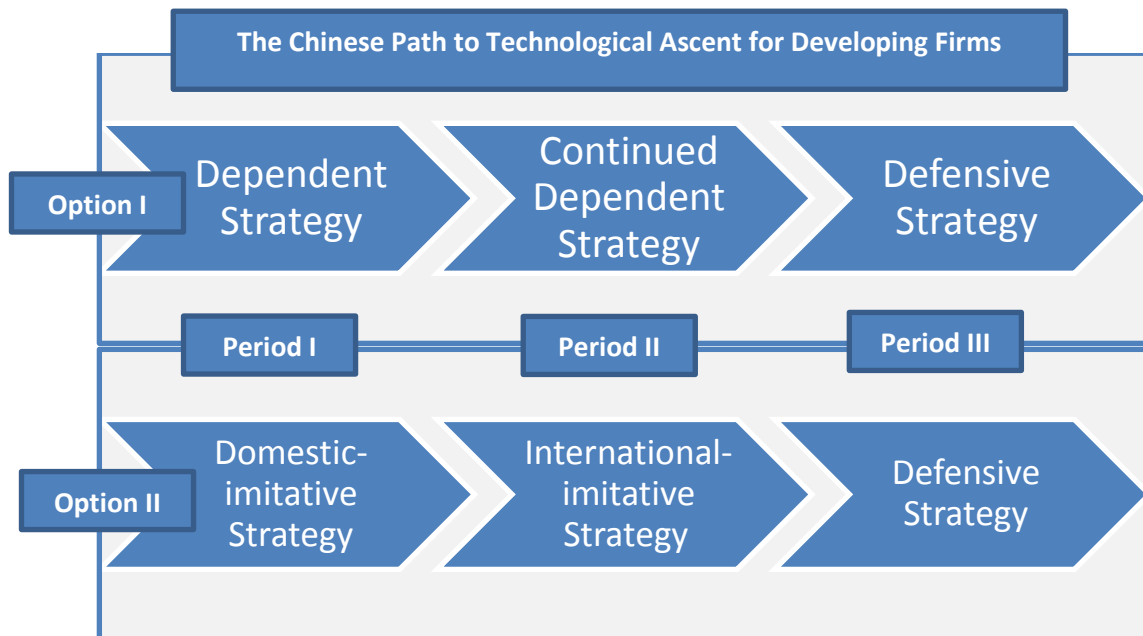


Figure 7: The Chinese Path to Technological Ascent for Developing Firms

The basis for the above ideal path to technological ascent (option II) is the consideration that the domestic-imitative strategy is best suited to cope with the initial deficit in technological capabilities and yet at the same time manages to build the firm's own technical expertise in the process of catching up (Xiao et al, 2013). This is a general assumption that can be considered true for any developing firm as they need to overcome their initial lack of technological capabilities as best as they can within their resources available. Once the first period has successfully been concluded, the next choice in technological strategy would be an international-imitative one that further allows the firm to build on their technological capabilities. However, with the source of imitated technology to be found internationally rather than domestically and, as such, to be more challenging for the developing firm. The Third and final step for the developing firm would be to adopt an defensive technology strategy as a result of its coming of age as a technologically successful firm, and hence, having the need to protect its own technological achievements from competitors and imitators.

Adopting this for the specific Chinese context and the above stated comments stands correct and the illustrated path can be considered the most promising one for success. However, as previously flagged out, the key characteristics of the firm are the bases for its ability to choose and successfully implement the most suited technology strategy for the firm's current stage of development.

A more general assumption resulting from the above table and the more detailed discussion in section 3.5.1 would be the more advantaged a firm is the more likely it will be to also succeed technologically. Based on the abundance of resources available, it is expected to be best capable of tackling a challenging technology strategy. However this seem to not be the case as most advantaged firms are opting for a less challenging dependent technology strategy that yield little long-term potential for technological development. Following on a previous example, the Chinese automotive industry is a field dominated by large sized SOEs operating in a strategically important industry sector that long has been favoured by the Chinese central government and up to this day enjoys a multitude of privileges. However until today, the industry has consistently failed to produce a Chinese technologically leading company within the automotive industry.

If the advantaged firms within the Chinese economy fail to successfully progress in their technological development, it raises the question which type of Chinese firms is most suited to technologically evolve into an indigenous innovator. Based on the previous sections and the considerations within them, the ideal type of firm for the path of technological ascent would be the one most likely to choose a domestic-imitative technology strategy at an early point in its technological development. The graphic below draws together the different ideal types of Chinese firms and their associated choice in technology strategy.

As it can be seen below, the domestic-imitative technology strategy is associated with firms of approximate parity or even disadvantaged ones leading the focus away from the more commonly looked at larger Chinese lead firms that base their success around their advantaged position within the national institutional context (Table 6).

Table 6: Domestic Chinese Firm Type and Technology Strategy Overview

Type of Domestic Chinese Firm	Technology Strategy
Large sized strategic coastal Majority SOEs	Dependent Technology Strategy
Large sized strategic coastal/inland Minority SOEs and POEs	International-Imitative Strategy
Large sized non-strategic coastal/inland Minority SOEs and POEs	Domestic-Imitative Strategy
Small/Medium sized non-strategic coastal/inland Minority SOEs and POEs	Domestic-Imitative/No Technology Strategy
Small/Medium sized non-strategic coastal/inland POEs	No Technology Strategy

Approximate parity and disadvantaged firms are less commonly researched within the Chinese focused literature as their technological development often takes place at a slower pace and as such, it is often overlooked. Yet it is these firms that carry the greatest potential to succeed in the long term development of technological capabilities.

These Chinese outlier firms are the ones that are of particular interest to this work as those of them that managed to become technologically successful can help to facilitate the understanding of what it takes for Chinese firms to become technologically successful. Starting from a disadvantaged point within the Chinese economy, they managed to overcome these hurdles and develop into indigenous innovative firms that have successfully taken the path for technological ascent for developing firms.

3.6 Chapter Summary

The previous chapter set out to link the general theoretical considerations of the second chapter and set it into a nation specific context for China in order to identify a

theoretical conceptualisation of the ideal path for technological ascent of developing firms in China.

Institutions in China are of great impact to the individual domestic firm as they shape the national economic environment and, in comparison to other Western economies, even go further and actively interfere in the operational aspect of business via multiple channels, such as SOEs, industry policies, and access control to key resources. Especially the accessing control to key resources controlled by the state institutions seems to impact domestic firms during their technological development. Some Chinese domestic firms are more advantaged in regards to access to centrally managed external resources via the national institutions. This leads to the underlying assumption that the ones that have better access to external resources, as a result, are automatically in a better position to accumulate the needed internal resources to become technologically successful. However, according to the ideal path of technological development, the concluded most viable technology choice does not align with the common choice of those firms with advantaged access to resources.

It is not the more advantaged firm that is the most likely to choose the more challenging imitative technology strategy, quite the opposite they more frequently decide to opt for a more expensive yet faster result yielding strategies. This is also rooted in the fact that these firms are often the ones that actually have the needed access to foreign firms to initiate the necessary technological exchanges for a technology strategy based on dependency. However, in turn smaller and less favoured firms struggle to access both the financial resources needed and the contact to technological foreign lead firms. This theoretical assumption would be in line with the observations of Chinese firm development of the past two decades. The most advantaged firms, whilst securing considerable market share and size, never managed to establish themselves as technologically innovative firms. This does not mean that there are no innovative and technologically successful firms in China – they do exist – however one might not find them where they would expect them to be.

In summary, more research focus should be given to the Chinese domestic firms, especially in light of a technological development path rather than an ad-hoc analysis of the firm's technological inventory. Many of the initially less advantaged firm are

forced to choose an imitative technology strategy for the lack of alternatives and, in the long term, achieve a technological advantage as they unbundle and further develop the technological knowledge obtained. As a logical consequence, this work will focus in its empirical work on two Chinese domestic firms that are technologically successful, although at the initial stage of their development they were at a disadvantage, they still managed to overcome this and become technologically successful.

The next chapter will elaborate on the research methodology that built the foundations for this study by looking at the initial research philosophy that guided the analysis. This is followed by further elaboration on the chosen sample and how the used data was obtained and analysed before concluding in a brief summary and turning to the empirical findings.

4. Research Methodology

4.1 Purpose of Chapter

This chapter will argue the underlying research methodology guiding this work. Section 4.2 will start with a discussion of the research design and the considerations that drive the methodological choices outlining the philosophical underpinnings. The section will cover the philosophical, epistemological, and ontological stance of the research. This will be followed by section 4.3, which will elaborate on the choice in cases and the theoretical sampling that has driven this choice. Also the section will give a brief overview of both cases and their relevance for this research. This leads to the discussion of both data collection and the subsequent analysis of it. The chapter will conclude in a summary in section 4.6 before turning to the empirical part of this work.

4.2 Research Design

This abductive research is designed as a paired case study (Eisenhardt, 1989; Reichertz, 2010). Case research design is well suited for the generation of theory (Gersick, 1988; Eisenhardt & Graebner, 2007), in particular to answer ‘how’ and ‘why’ questions (Merdith, 1998; Eisenhardt & Graebner, 2007). According to Bartunek, Rynes, and Ireland (2006), it generates some of the most interesting research which is accurate and insightful (Eisenhardt, 1989). Particularly, paired case studies, as a distinctive strategy of comparative analysis are suitable for generating in-depth insights (Tarrow, 2010). This approach lends itself for this research as paired cases can enable the creation of more complex theories than multiple case studies, because the research can fit its theory close to the in-depth details of a particular case (Eisenhardt & Graebner, 2007). The research questions of this work require to gain deep understandings of the cases studied lending itself to a paired case study design.

Specifically, this work analyses empirical data from two distinct and relevant case studies. The paired case study been built as a most-similar systems design, in which common characteristics are understood to be controlled for, whereas differences are viewed as explanatory variables (Tarrow, 2010). The two cases are both technologically innovative and internationally successful domestic Chinese firms which at early stages in their development have been at a disadvantaged position. This type of Chinese outlier firms are of particular interest for further research as they challenge

common theoretical perceptions. This particular setting lends itself well to this research.

Firstly, it is an underexplored setting, while there is substantial existing literature on the development of Chinese firms in various aspects. The Chinese outlier firms have not received much attention in the literature and yet their exceptional role is worth knowing to allow for a better understanding of the development of Chinese firms.

Secondly, so far most research into the technological choices of developing firms focused solely on certain points in time of the firm's development, rather than seeing the sequence of choices over a period of time. The focus on Chinese outlier firms allows for a small sample to be chosen and analysed in-depth over a wider period of time. This in itself differentiates this work's setting from research into the development of Chinese firms as described in point one.

In social sciences research questions often are bound into a narrative, a broad context influenced by many different factors, which are not always to be measured in a strict quantitative way (Flyvbjerg, 2011). In the particular case of this work, it is not only the complexity of the narrative needed to be considered to fully understand the bigger picture, but also the lack of sufficient access to quality quantitative data material which prevents the pursuance of a positivistic research approach. Consequently, following a less structured research methodology in order to generate qualitative data material to facilitate explanation and foster understanding seems to be more appropriate in this particular case (Crowther & Lancaster, 2009).

A pragmatic approach has been taken in terms of ontology with an external view chosen to analyse and be guided by the research question at hand (Saunders, Lewis, & Thornhill, 2009). The research will follow an abductive philosophical approach to guide its research logic (Thagard & Shelley, 1997; Reichertz, 2010). With this prior choice on the concept of ontology, the epistemology of the work will also be pursued in the tradition of critical realism. Epistemology is understood as the philosophical approach to theory building investigating the nature, grounds, limits, and validity of human knowledge (Crowther & Lancaster, 2009: 237). Critical realism is particularly suited for this research due to its inherent dynamism to cope with the complex set-up faced with in developing economies (Archer & Bhaskar, 2007).

Keeping the research question in perspective both observable as well as subjective meanings will be taken into consideration as acceptable providers of knowledge. Therefore, consequently once more distancing the methodological approach used from the positivistic one based on only directly observable phenomena for the reasons elaborated earlier in this chapter (Gill & Johnson, 2010). Following a positivist approach one cannot completely separate researcher and research objective, as the researchers' ontology and epistemology will inevitably influence the approach chosen and the data material evaluated is not solely based on quantitative material (Saunders et al, 2009). Nevertheless, this work is guided by a rational and objective approach on the data material at hand to solve the research questions. In terms of data collection it will be a multiple method design that relies on an extensive review of the existing literature in a broad spectrum of topics further substantiated by both quantitative and qualitative case studies in the respective fields.

The following section will move away from the research design and elaborate on the theoretical sampling and choice in cases.

4.3 Sample

The research will employ an in-depth case study methodology through use of interviews, focus group discussions and additional archival data (Hair & Money, 2007). Siggelkow (2007) argues the advantage of in-depth insights that can be generated through paired case studies. This approach is particularly appropriate as the area under investigation is explorative: causal hypotheses are constrained by the lack of existing knowledge, and the subject matter can only be investigated within its context (Bonoma, 1985). Previous research in the field has heavily relied on more focused approaches on data collection, such as cross-sectional surveys and questionnaires, causing the emergence of a 'bigger picture' within the research of China's institutional features and its impact on organisational capabilities to emerge (Cooke, 2008).

After the development of the theoretical framework the screening process for suitable cases started. A non-probability sampling method has been chosen, to be precise a selective sampling approach, as it is particularly suited to the setup of this research. Selective sampling is often criticised for its vulnerability to judgement by the researcher and its high levels of bias (Black 2010). However, Black (2010) argues that with sound judgement by the researcher to find a representative sample these

shortfalls can be overcome and selective sampling is a time and cost effective way to find suitable cases. According to Saunders (2009), selective sampling proves effective when only limited number of cases can serve as a primary data source due to the nature of the research.

The selection is based on the main criteria that each of the firms has been initially limited in their technological development potential, but is now successful in both the Chinese domestic and international market. Further the suitable sample been differentiated by: (i) ownership, (ii) size, (iii) sector, and (iv) industry as these aspects impact the firms choices in technology strategies and resulting path of development (Table 7).

Table 7: Overview of selection criteria for the cases

	Case I – Zhuzhou Times New Material Technology Co. Ltd. (株洲时代新材料科技股份有限公司)	Case II – Huawei Technologies Co. Ltd. (华为技术有限公司)
Ownership	State-owned	Privately Owned
Size (at initial starting point of development)	Small-medium	Small
Sector	Strategic Industry	Strategic Industry
Location	Remote Inland location	Central Coastal location
Initial Development Potential	Limited - due to disadvantaged access to key resources	Limited - due to disadvantaged access to key resources

Following selective sampling the paired cases been chosen based on their unusual relevance, extreme setting as an example, and opportunity for unusual research access (Yin, 2009).

Case One, Zhuzhou Times New Material Technology Co. Ltd. (株洲时代新材料科技股份有限公司) is operating in a medium-high technology sector. The Hunan based firm is a well-established producer for railway components, particularly rubber-metal composites and damping applications. The Shanghai Stock exchange listed firm is a fully state-owned subsidiary of China Southern Railway which now is part of China

Railway Rolling Stock Corporation (CRRC). As a state-owned firm based in a remote inland location the firm is predestined to struggle in its technological development based on the lack of access to foreign technology and lack of corporate governance structures to support innovation. Yet, the firm managed to become a serious contender in its industry with a strong national and international presence. Technologically successful state-owned firms are a rare find in itself and such this case is ideally suited for this research.

Case Two, Huawei Technologies Co. Ltd. (华为技术有限公司) is an in 1988 founded privately owned firm operated in the telecommunications sector. The majority of the firm's shares are owned by the employees and as such reflect a unique Chinese ownership structure. Private owned firms generally speaking are more likely to have the needed corporate governance structures to become successful innovators, however usually lack the needed external resources in China, such as access to finance, labour, or technology. Huawei managed to overcome all these hurdles in the early stages of its development and become a worldwide leading innovative industry leader. This clearly can be classified as an outlier firm in China and hence is ideally suited for this research.

Eisenhardt and Graebner (2007) reason that paired cases are typically utilised to explore significant phenomena under rare and unusual circumstances. For this research the cases have been selected based on their falling into the category of outlier firms. A common feature in both firms is that they have been successful in both the Chinese domestic and foreign market and can be considered leading firms in their field, however have initially been disadvantaged by traditional perceptions of technological advancement of developing firms. This makes them particularly suited for this research as to analyse the factors for success. Now the research design has been outlined the following section will look at the process of the data collection, including the pilot study conducted.

4.4 Data Collection

The main focus for data collection adopted was interview based, with many complementary sources of evidence such as archives, statistical material, external firm records, and financial data. In preparation for the data collection an initial interview schedule had been constructed to guide the semi-structured interviews. The interview schedule was initially constructed in English and in a second step translated into Mandarin, which for the purpose of cross-validation was back-translated into English with the help of a proficient Chinese-English bilingual speaker. This process has been implemented to ensure that any conflicts in language idioms and idiosyncrasies are resolved. Further, culturally-sensitive differences within the conduct of interviews and research was incorporated in the construction of the schedule and its following analysis.

Between March and April 2014, the developed interview schedule was used to conduct a pilot study with three UK based companies of different nationality in the same industry sector (Table 8). Three semi-structured interviews with senior managers of each firm were conducted as can be seen in the table below. This allowed testing the set of interview questions in regards to its suitability to answer the research objectives. Due to the different nationalities of the firm, it helped to gain a better understanding of different cultural response to questions asked.

Table 8: Pilot study - Case Overview

	Pilot Case I	Pilot Case II	Pilot Case II
Firm's Nationality	German	Chinese	English
Interviewees	Managing Director HR Manager Mid-level Employee	Managing Director	Managing Director
Length of Interviews	Approx. 60 to 80 minutes each	80 minutes	60 minutes

The rationale in choice of the pilot cases was rooted in the idea to trial the interview questions with interviewees from different cultural backgrounds. Further, the pilot

study has provided an additional opportunity for training and building confidence in conducting interviews. What is more, it allowed for practicing more pragmatic aspects such as time keeping, addressing sensible interview topics, and asking useful follow up questions. One of the main limitations of the pilot study is the low number of interviews. However, with the main purpose being training and building confidence in conducting interviews the number of interviews was less important rather than the seniority levels of interviewees and length of interviews. Further, it needs to be acknowledged that the pilot firms are operating in a different industry background than the two main case studies. This limited the questions on certain aspects such as for example employee contribution to be asked, yet a wide number of question on firm structure and characteristics still applied. In summary, irrespective of the limitations of the pilot studies they served their main purpose of training and building confidence very well. In addition, it allowed for the interview schedule to be tested against different cultural backgrounds (Cooke, 2002). With the main fieldwork taking place in China over a predefined limited period of time the pilot study allowed for a trial in interviews, which could not be accommodated during the main fieldwork.

The tables below give an overview of how the research questions and their linked theoretical concept have guided the development of the initial interview schedule and corresponding interview questions. Further, the table links the respective research question to the source of data used to answer it.

Table 9: Overview - Theoretical concepts, interview question and data source

Research Question (RQ)	Linked Theoretical Concept	Corresponding Interview Question	Source of Data
<p>Research Question I: <i>What is the optimal path to superior organisational capabilities for Chinese domestic Firms and how have National Institutions shaped the firms path to technological ascent so far?</i></p>	The Role of the State	<ul style="list-style-type: none"> • How reliable are formal institutions? • How would you rate the ease of doing business? E.g. obtaining licences • How do interactions with formal institutions differ from a local to central level? 	<ul style="list-style-type: none"> • Expert Interviews – Academia; Interview 20 • Expert Interviews – Entrepreneur • Expert Interviews - NGO • Supporting Literature
	The Financial System	<ul style="list-style-type: none"> • How easy is the access to external capital? • In what ways is the banking system influence by the state in China? • What role does the stock market play as a source for capital? 	<ul style="list-style-type: none"> • Expert Interviews – Academia; Interview 20 • Expert Interviews – Banking/Finance • Expert Interviews - NGO • Supporting Literature
	The Skill Development System	<ul style="list-style-type: none"> • How has the educational system in China changed in the last decade? • Are vacancies filled quickly? If not, which ones are these? • Does vocational training play a role in China? 	<ul style="list-style-type: none"> • Expert Interviews – Academia; Interview 20 • Expert Interviews – Entrepreneur • Expert Interviews – NGO • Expert Interviews – HR • Supporting Literature
	The Authority and Trust System	<ul style="list-style-type: none"> • How reliable is the Chinese legal system? • What roles play contracts in business? Has this changed over the last two decade? • What is the on ground effect of Chinese legal legislation? 	<ul style="list-style-type: none"> • Expert Interviews – Academia; Interview 19 • Expert Interviews – Legal Consultant, Interview 9 • Expert Interviews - NGO • Supporting Literature

<p><u>Research Question II:</u> <i>How did those Chinese domestic firms that succeed in developing superior organisational capabilities achieve it and to what extent have the National Institutions supported this process?</i></p>	<p>Financial Capability</p>	<ul style="list-style-type: none"> • Who are the major lenders? For example, how are loans obtained? • How often – if any – does the firm report financial results? • Who are the firm’s major creditors? • Which services did the major bank(s) provide for the enterprise? And how are banks chosen for each service? 	<ul style="list-style-type: none"> • Case Interview – e.g. A.1; A.3; B.1; B.3 • Expert Interviews – Banking • Expert Interviews – Finance • Annual Reports • Company Publications • Supporting Literature
	<p>Operational Capability</p>	<ul style="list-style-type: none"> • What role, if any, do the owners/high level management play in the day to day running of the firm? • Who can decide on changes in senior personnel? Who casts the final vote? • Who initiates product and technology changes? • What is the short-/medium-/long-term strategic goal of the firm? How did it change in the course of the firm’s development? 	<ul style="list-style-type: none"> • Case Interview – e.g. A.1; A.3; B.1; B.3 • Expert Interviews – Consulting • Expert Interviews – Manufacturing/Automotive • Company Publications, e.g. Mission Statements • News coverage in trade publications • Supporting Literature
	<p>R&D and Technical Capability</p>	<ul style="list-style-type: none"> • What is the firm’s technological ambition? • Number of staff engaged in research and development? • Number of new products/services introduced in this year in comparison to your main competitors? 	<ul style="list-style-type: none"> • Case Interview – e.g. A.1; A.3; B.1; B.3 • Expert Interviews – Consulting • Expert Interviews – Manufacturing/Automotive • Patent Applications • News coverage in trade publications • Supporting Literature

<p>Research Question III: <i>Under what conditions, both external and internal, are Chinese domestic firms likely to develop superior organisational capabilities?</i></p>	<p>Ownership</p>	<ul style="list-style-type: none"> • Did you ever encounter difficulties in doing business due to your type of ownership? • Are state-owned and privately owned firms treated equally? • How important are private firms overall within the Chinese economy? 	<ul style="list-style-type: none"> • Case Interview • Expert Interviews • Supporting Literature
	<p>Size</p>	<ul style="list-style-type: none"> • How did the changes in size impact your perception as a firm across stakeholders? • What have been the key growth periods for the firm? • Generally speaking, does firm size matter in China? 	<ul style="list-style-type: none"> • Case Interview • Expert Interviews • Supporting Literature
	<p>Sector</p>	<ul style="list-style-type: none"> • Did you ever struggle to access certain sectors? • Are state-owned and privately owned firms treated equally? • Does state interference differ depending on industry sector? 	<ul style="list-style-type: none"> • Case Interview • Expert Interviews • Supporting Literature
	<p>Location</p>	<ul style="list-style-type: none"> • Did you ever encounter difficulties in doing business due to your location? • Is qualified labour widely available in your area? • What advantages/disadvantages would you say comes with your geographical location within China? 	<ul style="list-style-type: none"> • Case Interview • Expert Interview • Supporting Literature

An initial set of 11 interviews has been conducted by the author between July and September 2014 (Table 10). All interviews were held individually and lasted around 60 minutes. Interviews were carried out in English, German, or Chinese and mostly recorded by hand-written notes during the interviews. As Cooke (2002) states in her work, tape recording is very difficult in China and most interviewees are reluctant to accept it. If consent was obtained from the interviewees, interviews were recorded accordingly and if not extensive notes have been taken during the interviews. The initial contact to interviewees was generated through the author's personal network in China and resulting introductions to interviewees. This helped to gain a trusted relationship with interviewees based on a personal relationship, which is particular importance in China. A referral technique was used to be introduced to further interviewees within the respective firm allowing to contextualise and verify the results of the previous interviews. In the interviews adjusted sets of questions had been used in accordance to the interviewees' operational role. After an initial data analysis, another four interviews been conducted during December 2014 and January 2014 to collect additional information and to verify the existing data analysed (Table 10).

All interviews conducted, both for the cases and additional ones, have been semi-structured in their approach and did not follow a rigorous set of questions. The interviews been guided by the interview schedule (Appendix) and its overarching themes, yet not been solely restricted to a fixed set of questions (Yin, 2008). All interviews have been structured through following the three main themes: (i) Company Profile, (ii) Market Organisation, and (iii) Coordination and Control. These three been further categorised into sub-sections, such as for example ownership, product and technology, customer/supplier relations, and labour management. A flexible approach has been taken as to how in-depth these subsections been discussed and how much time been allocated to each of them.

This approach allowed to follow topical trajectories during the interviews and to stray in questions if appropriate. The resulting flexibility permitted for questions to be tailored to the interview context, situation, and interviewee.

Table 10: Overview - Interviews cases I and II

Case Interviews	Job Role	Date of Interview	Length of Interview	Case Firm
First Set of Interviews	July to September 2014			
Interview A.1	Senior Business Development Manager	04/07/2014	45 Minutes (Telephone)	Case I - TMT
Interview A.2	Key Account Manager	06/07/2014	50 Minutes (Telephone)	Case I - TMT
Interview A.3	General Manager	09/07/2014	95 Minutes	Case I - TMT
Interview A.4	Office Clerk	09/07/2014	25 Minutes (Telephone)	Case I - TMT
Interview B.1	Research & International Outreach	17/07/2014	60 Minutes	Case II - Huawei
Interview A.5	Business Development Manager	06/08/2014	45 Minutes (Telephone)	Case I - TMT
Interview A.6	Business Development Manager	08/08/2014	70 Minutes	Case I - TMT
Interview B.2	Admin Supervisor	18/08/2014	40 Minutes (Telephone)	Case II - Huawei
Interview A.7	Investment Project Manager	19/08/2014	80 Minutes	Case I - TMT
Interview B.3	Sales Manager	20/08/2014	50 Minutes (Telephone)	Case II - Huawei
Interview B.4	Associate HR Practice	26/08/2014	45 Minutes (Telephone)	Case II - Huawei
Second Set of Interviews	December 2014 to March 2015			
Interview A.8	General Manager	03/01/2015	55 Minutes (Telephone)	Case I - TMT
Interview A.9	Investment Project Manager	07/01/2015	60 Minutes	Case I - TMT
Interview B.5	Research & International Outreach	11/03/2015	35 Minutes (Telephone)	Case II - Huawei
Interview A.10	Business Development Manager (I)	17/03/2015	50 Minutes (Telephone)	Case I - TMT

The data has been further enriched through additional interviews, such as informal discussions with leading scholars in the relevant fields during two conferences in Manchester and Beijing. Further personal communications with established Chinese scholars from two Chinese universities has helped to put the obtained data into a wider context. According to Crossland and Hambrick (2011), the main advantage of including experts in the process of data collection is their ability to combine their familiarity of the scientific body of knowledge with tacit knowledge of the cases. In regards to the usage of archival data, Glinow and Teagarden (2009) argue that scholars from diverse backgrounds can better explicate the relative qualitative insights that are often hidden in archival data. These additional interviews had not been limited to academic scholars but also industry experts on different aspects of the Chinese economy been interviewed to draw on their insights (Table 11). The rationale for conducting these interviews was to add to the wider understanding of China's economic and institutional environment, as well as, helping to place the interview responses into a wider context. For example, the discussions with two native Chinese senior employees in the banking sector helped greatly to both gain a better understanding of the financial institutions and its implications for firms. Talking with consultants in various industries helped to gain a better understanding of firm's best practices in China and in how far the case study firms deviate from these. Further, these interviews offered an opportunity for cross-validation of responses beyond the internal focus of the respective case firm's interviewee.

Table 11: Overview - Additional interviews

	Industry	Job Role	Date of Interview	Length of Interview
First Set of Interviews	July to September 2014			
Interview 1	NGO	Researcher	07/07/2014	65 Minutes
Interview 2	Entrepreneur	Owner – Small Service Firm	08/07/2014	90 Minutes
Interview 3	Automotive	Senior Manager R&D	16/07/2014	90 Minutes
Interview 4	NGO	Researcher	16/07/2014	50 Minutes
Interview 5	Automotive	Governance, Risk, & Compliance Officer	17/07/2014	70 Minutes
Interview 6	Banking	Senior Analyst	23/07/2014	55 Minutes
Interview 7	Banking	Relationship Manager, Wholesale Banking	25/07/2014	50 Minutes
Interview 8	Banking	Senior Analyst	28/07/2014	45 Minutes
Interview 9	Legal Consultant	Insolvency Lawyer	29/07/2014	40 Minutes
Interview 10	Business Consultant	Consultant Finance & Accounting	29/07/2014	75 Minutes
Interview 11	Food Manufacturing	Marketing Manager	29/07/2014	70 Minutes
Interview 12	Business Consultant	Operations Consultant	30/07/2014	55 Minutes
Interview 13	Consulting	Marketing & Customer Relationship Manager	06/08/2014	65 Minutes
Interview 14	Consulting	HR Manager	06/08/2014	70 Minutes
Interview 15	Automotive	Head of Product Strategy	11/08/2014	90 Minutes
Interview 16	Automotive	Change Management & Communication	13/08/2014	95 Minutes
Interview 17	Manufacturing	Plant Manager	16/08/2014	85 Minutes
Interview 18	Finance	Director	20/08/2014	80 Minutes
Interview 19	Academia	Research Fellow; Chinese Legal System	25/08/2014 (Telephone)	40 Minutes
Interview 20	Academia	Prof. Contemporary Chinese Studies	25/09/2014	45 Minutes
Second Set	December 2014 to March 2015			

of Interviews				
Interview 1	Automotive	Service Planning Manager	30/12/2014	50 Minutes
Interview 2	Manufacturing	UX Researcher, Research & Technology	31/12/2014	50 Minutes
Interview 3	Oil & Petro-Chemicals	General Manager, Northern China	04/01/2015	75 Minutes
Interview 4	Entrepreneur	Owner – Small Manufacturing Firm	05/01/2015	50 Minutes
Interview 5	Consultant	Associate Consultant	06/01/2015	65 Minutes
Interview 6	NGO	Researcher	06/01/2015	80 Minutes
Interview 7	Academia	Research Fellow, Chinese Studies	07/01/2015	60 Minutes
Interview 8	Manufacturing	Sales Coordinator, China	17/03/2015 (Telephone)	45 Minutes
Interview 9	Finance	Director	19/03/2015 (Telephone)	80 Minutes

The collected data was in a second step complemented by additional sources of evidence. According to Yin (1994), internal validity and reliability can be ensured through the usage of multiple different qualitative and quantitative sources. Triangulation of various sources of data is required to build reliable case narratives, robust conceptual insights, and build theory with validity (Jick, 1979; Yin, 2008). Archival records, for both cases, had been used to gain a deeper understanding of the development of the respective firms at different points of time. Further, to understand the development in technology strategies published statistical data from sources such as OECD, State Intellectual Property Office (SIPO) of China, and National Bureau of Statistics of China were used. It needs to be noted, that the archival data available for China, as it is the case for most developing economies, often tends to be incomplete and not necessarily live up to Western standards (Fainshmidt, 2016). Where possible it has been tried to verify archival data by cross checking various source to better judge the accuracy. Case Two especially utilised the wide field of additional published sources and draws on the rich materials available in Harwit (2008) and Breznit (2011).

4.5 Data Analysis

For the data analysis the manual coding approach was used for the content analysis of the data material and to guide further research within it. Coding has been proven to be a useful approach to identify and conceptualise the underlying content amongst the 'noise' of the data (Eisenhardt, 1989). According to Charmaz (2006), coding generates the bones for analysis. Theoretical integration will assemble these bones into a working skeleton. Thus, coding is more than a beginning; it shapes an analytic frame from which you build the analysis (Charmaz, 2006, p. 45). Eisenhardt (1989) insist on having an unbiased approach on the data analysis in order to not force preconceived ideas on the data by trying to support a predefined concept. This should not be confused with a call for unfocused investigation but should admonish the researcher to constantly reevaluate the underlying conceptualisation of data analysis and keep an open mind for the analysis to evolve.

In this particular case the a priori codes are aligned along the general multi-layered structure of national, industry, and firm level pursued within this work in order to initially confine the vast amount of data. Subsequent steps of the analysis been to read through the data and mark those segments with relevance to the research questions and where such segments are in correspondence to the a priori themes, they are coded as such, otherwise new codes are defined to include the relevant material and are organised into an initial template. This initial template was monitored and modified throughout the entire research process in the light of careful consideration for the data material at hand. The variables covered areas as the firms' technological strategies, number of patents, level of capabilities, governance structure, financial circumstances, expansion plans, and market development. This final template was used as basis for the interpretation of the data set by the researcher. The templates for both cases were than analysed in a cross-case comparison, to identify similarities and differences in the evolution of the mentioned variables.

After transcribing the interviews and setting up both case studies the analysis of data started by iterating between data and theory using Whitley's (1999) frameworks on institutional divergences as the main theoretical guidance (Van de Ven, 2007). This resulted in an initial set of high level codes to start with. Organising the data in various

tables and graphics (Miles and Huberman, 1994), the high level codes been used to systemise the data within each case and to further create and test other codes on lower hierarchy levels. Firstly, each case been analysed independently to form individual views of each case and to avoid bias. Secondly, the cases have been compared and contrasted against each other with the aim to find both consistencies and inconsistencies within the cases (Eisenhardt and Graebner, 2007). Continuously iterating between data and the research questions the findings have been slowly refined and the contribution emerged based on the qualitative data. The continuous process of iteration and reiteration further strengthened the internal validity of the research (Yin, 2008).

Based on Eisenhardt's call to abandon all preconceived ideas one could argue that this leads to an inevitable tension with the case study approach conducted in this work (Eisenhardt, 1989). Since the case study paradigm states a clear beneficial contribution to the research outcome if guided by a previously developed theoretical proposition to guide the process of data collection and analysis; it is therefore crucial to stress once more that the initial intention is to use an open minded approach on determining the concepts grounded in the data and utilize those concepts to build theory (Yin, 1994).

It has been considered within the wider analysis that data quality is a prevalent issue in China. Especially specific and concrete information of Chinese firms are hard to obtain and often cannot live up to the standards of Western researchers in terms of data quality. This imperfection in data quality needs to be incorporated as it is a consistent issue throughout China related research and cannot be fully circumvented by the researcher. The accessibility of information within the Chinese telecommunication and railway industry pose a certain degree of constraints to the research as these industries are considered pillar industries and there is a considerable reluctance for sharing information beyond industry circles.

4.6 Chapter Summary

In summary, the research used an abductive approach with a paired case study of two technologically successful domestic Chinese firms. The objective was to respond to the limitations of the debate around innovativeness of Chinese domestic firms, in particular the focus on the path of technological development and the choices in technological strategy. Management and employee perspectives have been included in both cases which also been further validated by additional external data. Further, additional supporting interviews have been included into the research to widen the scope of analysis.

The chapter also outlined the significant challenges associated with gaining access given the sensitive nature of the research for both case studies. Further, the more country specific challenges associated with China related research been outlined, such as the general issue of data reliability and the culturally rooted issues faced during interviews. This is important as gaining access to a significant number of both individual case and general research related interviews along with the theoretical analysis of supporting documents is a significant achievement of this research. The conducted pilot study further helped to develop the interview schedule and subsequently the interview questions asked. Now the methodology has been outlined the next chapter will explore the empirical findings of both cases researched. Both cases look at domestic Chinese firms that managed to become technologically successful and will analyse their path to technological ascent.

5. Empirical Findings

5.1 Purpose of Chapter

The following chapter will build on the previous discussions of this work and analyse two case studies of technologically successful Chinese firms. The cases help to illustrate the interrelation of national institutions, firm characteristics, and choices in technology strategy on the successful technological ascent of Chinese domestic firms. Rather than looking at each case as a temporal snapshot, the chapter will analyse the firm's interactions and development across several periods in their technological ascent.

In order for domestic Chinese firms to successfully master the path of technological ascent they need to possess certain firm characteristics to overcome the limiting factors they face. These factors are linked both to internal characteristics and limitations faced by the individual firm, and also to the availability, or lack of availability of external resources, created through the setup of national institutions. Neither the external influences in form of the national institutions, nor the internal ones in form of key firm characteristics are static in nature. Rather they are in constant flux as firms develop along the path of technological ascent. The cases will illustrate critical turning points in the firm's technological development and how the national institutions and key stakeholders of the firm contributed.

Further, the chapter will show how those technology strategies that are realistically viable for domestic Chinese firms to successfully advance in their technical development evolve over time. The successful implementation of a chosen technology strategy is dependent on both the availability of internal firm characteristics, as well as on the availability of external resources available through the national institutions. What is more, the firm needs to choose the right technological strategy, at the right point in time of their development along the path of technological ascent, to succeed. This particular linkage of time, internal, and external factors will be further exemplified and analysed through the presented cases below. Irrespective of initially being disadvantaged both firms managed to overcome their limitations and become technologically successful in their respective fields domestically and internationally. Zhuzhou Times New Material Technology is an innovative state-owned enterprise

based in a remote geographical location and operating in the railway component industry. Huawei is a successful private owned telecommunications equipment manufacturer based in a coastal area. This raises the question of how both managed to become technologically successful. Both cases will be analysed in further detail in the below sections to come.

5.2 Zhuzhou Times New Material Technology

The purpose of the case of Zhuzhou Times New Material Technology (TMT) is to illustrate the correlation between national institutions, firm characteristics, and available technology strategies. All of which have been theoretically elaborated on in the chapters two and three. Zhuzhou Times New Material Technology succeeded in becoming a technology leader within their industry by initially pursuing a domestic imitative technology strategy, followed by an international imitative one, and finally on becoming technologically mature and turning to a defensive technology strategy. TMT's technological success is not only a success on the firm level, but also a system level success. The entire railway industry within China had a coherent approach on innovation which benefited TMT in their development. Firm level success is understood in this occasion as being rooted only within the skill set based in the individual firm, while industry level success is understood as the industry as a whole becoming technologically competitive on an international stage. For China there are few industries that can classify as such a success story and the railway industry is one of them (Hong Wu & Nash, 2000).

TMT is a successful state-owned Chinese enterprise which is an innovative leader in its industry. It is successful both domestically and internationally, and as such can be considered an anomaly amongst Chinese state-owned firms (Harwit, 2008; Liu & Tylecote 2016, Xiao et al, 2010). TMT managed to successfully innovate despite is unfavourable external set up in a remote geographical location being comparatively small in firm size. TMT managed to overcome its internal limitations associated with state ownership making it an ideal case for the illustration of the interdependence of national institutions, firm characteristics, and choice in technological strategy for a successfully innovative domestic Chinese firm.

The below chapter will for one analyse the firms passage of technological development since its founding and for two illustrate how the firm managed to successfully master the technological ascent by utilising both its internal and external resources to overcome the shortfall of being a remote located SOE within the wider Chinese economy.

5.2.1 Zhuzhou Times New Material Technology Background and History

Zhuzhou Times New Material Technology Co. Ltd. (株洲时代新材料科技股份有限公司 - Zhūzhōu Shídài Xīn Cáiliào Kējì Gǔfèn

Year	Key Event
1984	Foundation of the “Rubber Laboratory”; invested by the Zhuzhou Electric Locomotive Institute under the control of the Ministry of Railway
1989	Reformed into an independent accounting and self-financing Rubber Technology Development Division
1994	Being reformed into: “Zhuzhou Times Rubber & Plastic LLC”. TMT becomes supplier to GE
1995	First exports to USA, Burma, and Thailand
1998	Legal status changed into Co. Ltd.
2001	Renamed into “Zhuzhou Times New Material Technology Co. Ltd.”
2002	IPO at the Shanghai Stock Exchange
2004	TMT being recognised as “state accredited enterprise technology centre” by the Chinese Ministry of Science and Technology Cooperation with Bombardier as strategic supplier started
2008	Annual sales revenue exceeded one billion RMB
2010	Market value of TMT reaches ten billion RMB
2013	Acquisition of ZF Sachs’s German rubber & plastic business unit Borge

Yǒuxiàn Gōngsī) – TMT for short – was founded in 1984 as “The Rubber Laboratory” by the Zhuzhou Electric Locomotive Institute (Zhuzhou Times New Material Technology, 2014). The institute at that time was under the direct regulation by the Chinese Ministry of Railway (MOR).

In 1989 it was transformed from a research institution into an independent accounting and self-financing development division for rubber technology. In 1994, TMT moved one more step away from being a research facility by re-firming as Zhuzhou Times Rubber and Plastic LLC and changing its legal status into the one of an enterprise (Zhuzhou Times New Material Technology, 2010). In 2001, the direct predecessor of TMT, Zhuzhou Times Rubber and Plastic Ltd. changed its name into Zhuzhou Times New Material Technology Co. Ltd. In 2002,

the company was listed at the Shanghai Stock Exchange and by 2010 reached a registered capital of 23.5 million Renminbi (RMB) (approx. 27 million pound sterling) (Bloomberg, 2014).

TMT's main areas of business split into three different product categories: (i) noise, vibration, and harshness components (NVH for short) – these are vital parts in train damper technology; (ii) polymer composite materials; and (iii) special coating and innovated insulation materials (Zhuzhou Times New Material Technology, 2014). The company's roots are firmly grounded within the railway industry, which still is its main operational focus. However, the company has over the years ventured into a wider field of business operations. These include automotive plastic moulds, electrical insulation materials, engineering plastic products, sealing technology, and wind power applications (Zhuzhou Times New Material Annual Report, 2010).

The key market for TMT is the Chinese domestic market with a majority of products being produced to meet domestic demand. However, TMT also supplies foreign markets such as the USA, Europe, and South Asia. TMT mainly supplies the railway industry with its products, but also caters for the automotive, wind energy, bridge building, and shipping industry. TMT's main customers are leading rolling stock manufacturers such as General Electric, Bombardier, Alstom, Electro-Motive Diesel, or Siemens. Further, TMT supports small distributors with parts and components and also offers service contracts to railway operators such as NY Metro and London Thames Network (Interview II).

5.2.2 Zhuzhou Times New Material Technology – Ownership Structure

TMT is a member of the China Southern Railway (CSR) Electric Technology & Material Engineering Research Institute (南车株洲电力机车研究所有限公司 – Nánchē Zhūzhōu Diànlìjīchē Yánjiūsuǒ Yǒuxiàngōngsī) – also referred to as CSR Zhuzhou Institute (中国南车株洲所 – Zhōngguó Nán Chē Zhūzhōu Suǒ) – which was established in 1959 as the Zhuzhou Electrical Locomotive Research Institute of Ministry of Railways (铁道部株洲电力机车研究所 – Tiědàobù Zhūzhōu Diànlìjīchē Yánjiūsuǒ) (CSR Zhuzhou Institute, 2014). The CSR research institute is a conglomerate of state owned firms with a focus on railway production that pool their R&D efforts in order to

unbundle and further develop leading technology in the industry. Member firms of the CSR Research Institute are as per below table:

Table 12: Member firms of the CSR Research Institute

CSR Electric Technology & Material Engineering Research Institute

Zhuzhou CSR Times Electric Co., Ltd
Zhuzhou Times New Material Tech. Co., Ltd. (TMT)
Zhuzhou National Engineering Research Centre of Converters Co., Ltd
CSR Zhuzhou Electric Locomotive Research Institute Wind Power Business
Hunan CSR Times Electric Vehicle Co., Ltd
Beijing CSR Times Locomotive and Rolling Stock Mechanics Co., Ltd.
Xiangyang CSR Motor Technology Co., Ltd
CSR Zhuzhou Times Hi-tech Industry Guarantee & Investment Co., Ltd

The firms are interconnected to each other beyond their joint membership in the CSR Research Institute (Table 12) through a series of cross-shareholdings between the different firms involved. TMT is for example directly linked to Zhuzhou CSR Times Electric Co. Ltd, CSR Zhuzhou Electric Locomotive, and CSR Zhuzhou Electric Locomotive Research Institute (CSR Annual Report, 2013).

CSR Zhuzhou Institute summarises its own technological development as follows:

“By strategy of technology introduction, digestion and absorption combined with independent innovation, CSR Zhuzhou Institute has been equipped with the strong capability of independent R&D and technology innovation, has finished the reconstruction of the independent R&D and innovation platform in the field of railway transportation electric traction and control systems, and had processed the advanced core technologies, [...], and synchronously has completed the development of design, manufacturing, and testing platform.”

(CSR Zhuzhou Institute, 2015)

The institute runs – amongst other research activities - two doctoral working stations and three overseas research institutes in the United States, the United Kingdom, and Australia. The research institute is today a wholly owned subsidiary of China South

Locomotive & Rolling Stock Co. Ltd. (中国南车股份有限公司 – Zhōngguó Nánchē Gǔfèn Yǒuxiàngōngsī).

TMT's close ties to China South Locomotive & Rolling Stock Co. Ltd. (short: CSR) do exceed their cooperation and membership in the CSR Zhuzhou Institute. Even though CSR's Annual Report only mentions a minority share in TMT (27.38 per cent), the company is a de-facto wholly owned subsidiary of state-owned CSR (CSR, 2014). On the 24th of May 1994, CSR obtained the previously mentioned 27.38 per cent in TMT and noted with respect to this the following in the foot notes of their Annual Report:

“The directors are of the opinion that the Group (CSR) obtained a de facto control over Zhuzhou Times New Material technology Co. Ltd. (*ZTNM*) as the Group obtained a majority of seats in the board of directors of ZTNM and held 41.28% of the voting rights in shareholder meetings of ZTNM.”

(CSR Annual Report, 2013)

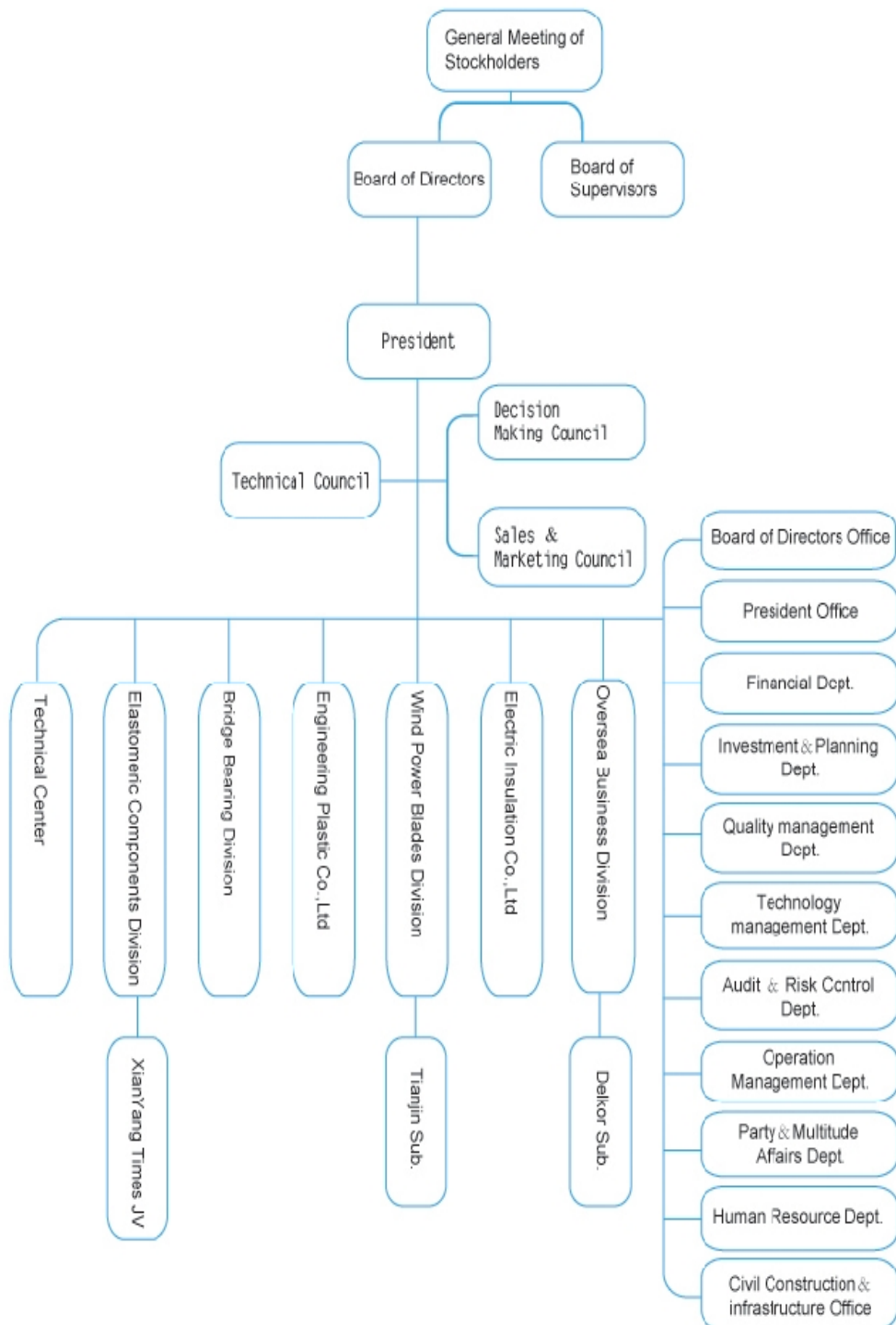
The above statement clearly shows the close linkage between the state-owned CSR and the stock market listed TMT. Regardless of its minority stake within TMT, CSR has secured a majority on the board of directors and a strong foothold in the voting rights. Both of which allow CSR to strongly influence the direction TMT is taking.

5.2.3 Zhuzhou Times New Material Technology Governance Structure

Zhuzhou Time New Material Technology in its modern form started out as a research facility under direct control of the Chinese Ministry of Railway. It is important to bear this historic root of the firm in mind when looking at its current governance structure. In its early years, between the founding in 1984 and the new set up in 1989, TMT was not a firm in the usual sense but, as mentioned in the previous history section of this chapter, a rubber research laboratory. In 1989 as the reform and opening policy of China's economy and society proceeded, the laboratory was turned into a self-financing and independent enterprise. This unusual development path until today is reflected in the firm's firm characteristics and in its strong focus on research and engineering applications.

TMT's governance structure is similar to the one of other state-owned enterprises (SOE) of this size, with the Board of Directors at the top of a hierarchical organisational

Figure 8: TMT Organisational Structure



structure (Figure 8).The president (CEO) is under direct supervision of the board of directors and supervisors, while he in turn is heading the Sales and Marketing, Technical, and Decision Making Council in collaboration with several deputy general managers. These three councils are based over the seven different business units of

the firm and guide these in their decisions. It is worth to point out however that the Overseas Business Unit operates in a different set up than the other units, as it is strongly focused on the development of overseas markets and as such works in close cooperation with the sales and marketing council. Further, the overseas business division is in charge of scouting out suitable firms for acquisitions or joint-ventures to expand the firm's international presence. For these decisions it works closely with both the CEO and respective councils (Interview A.1, A.2 & A.5). The supporting functions are grouped to the right, operating across the different business units.

The management team of Zhuzhou Times New Materials is unusual in its composition for a state-owned enterprise of this size. The key management people have been in their respective positions for 5.75 years on average, showing a long-term commitment to their respective roles, rather than aiming at a fast career progression. Key personell such as the CEO has been in power since 2009. The chairman of the board, Hongpin Zeng, was in position since 2008, and has been replaced only in February 2016 by Donglin Li at the age of 61 (Zhuzhou, 2016). The new appointed chairman has been with CSR Zhuzhou since 1989 and previous roles within the company included: Deputy Chief of Engineer of Rail Traffic Division, Director of Manufacturing Centre, and Deputy General Manager of Sales and Marketing Centre (CSR, 2015). As can be seen from the above roles, his background within the firm covers a wide range of functions, allowing him to have a wide and well founded understanding of the firms inner dealings. Further, his educational background spans from a Bachelor degree from Southwest Jiaotong University in electric traction and transmission control obtained in 1989, to a Masters degree of management in science and engineering from Hunan University (CSR, 2015). This sits well in line with the generally high levels of industry related education that can be found within the managerial team of TMT. Out of the 18 members of the key managerial team, three members hold a PhD in engineering. Further three independent directors are university professors at Southwest Jiaotong University, Hunan University, and Zhejiang University. It surely is no coincidence that both the Chairman and CEO have degrees from one of the three universities represented in the above list, showing the close linkage between TMT and these universities. Further, the average age of the management team of TMT is figures 47

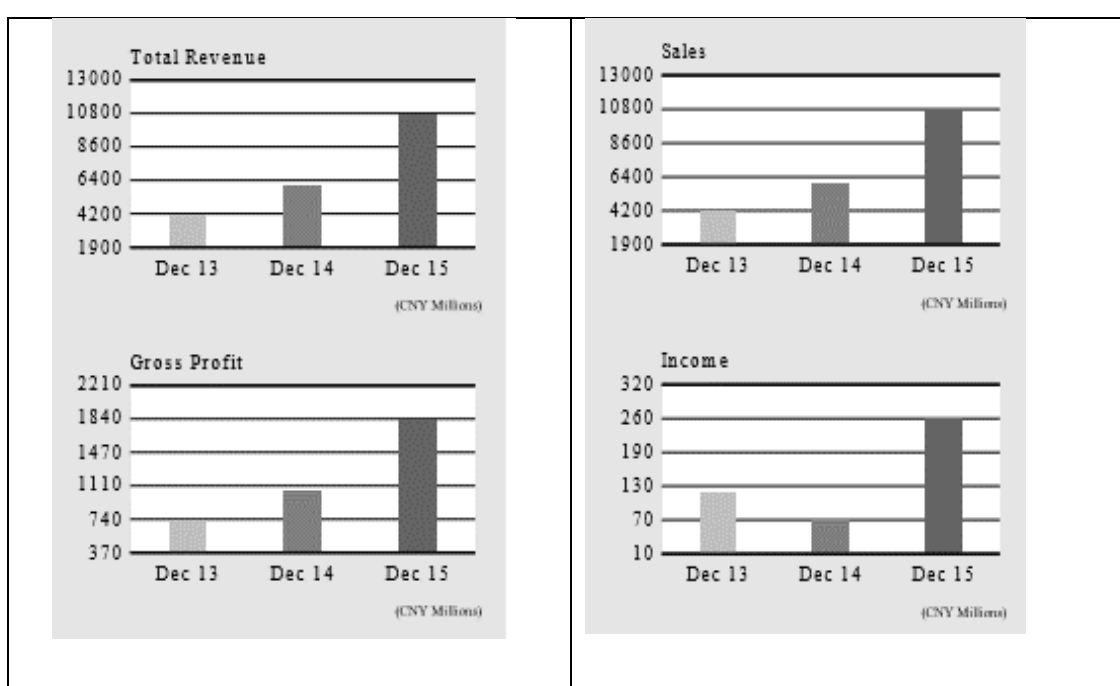
years and as such even lower than the average age of second wave management teams in Chinese SOEs (Kou & Zang, 2014).

The General Manager of Zhuzhou Times New Materials, Jun Yang (43 years old), has been in his position since 2009 and has a similar vita as the Chairman of the Board, Donglin Li. Jun Yang joined the firm in 2001 after his graduation from South China University of Technology, holding a PhD degree in engineering and majoring in materials process engineering (Zhouzhou, 2016). During his time with the firm he held several key positions in different departments of the firm, each with a strong focus on technology: Assistant of the Chief Engineer, Chief Engineer and Director of the TMT Technology Centre, and Vice General Manager and Director of TMT Technology Centre (Zhuzhou, 2016). Jun Yang is a good example for key managers of TMT being rotated in different positions within either the firm itself or other Zhuzhou based railway industry firms of the wider CSR group. A look at the biographies of key TMT managers shows their strong connection to Zhuzhou and the local area as most of them have worked in the multiple Zhuzhou based railway firms owned by CSR. The management team of TMT is in opposition to the expected findings for a state-owned firm, where usually external managers are parachuted into the company from a ministry background and usually are driven more by political motivations, than economic ones (Leutert, 2016). At Zhuzhou Times New Materials, however, the management personnel in large parts has both an academic degree and a strong industry background, in addition to also having worked for the firm for a considerable amount of time. This particular set-up makes the management team of TMT knowledgeable on the firms' technological needs. Further, they understand the industry development which allows them to make informed decisions on the choice in technology strategy of the firm. Further, the managerial team is strongly engaged in the firm's development due to their long-standing relation with the firm and the manager's local roots. This stands in contrast to the set up usually found in SOEs, where by politically motivated the Beijing shuffle descends managers onto firms and repositions them often. Under the Xi administration this has become even more frequent (Leutert, 2016). Again TMT opposes this model with its managers being engaged for the longterm.

5.2.4 Zhuzhou Times New Material Technology Performance Indicators

By 2016 Zhuzhou Times New Material Technology employed 6,981 employees and had a market capitalisation at the Shanghai Stock Exchange of 13,92 billion RMB (approx. 16.1 million pound sterling) (Reuters, 2016). The sales turnover for TMT grown continuously over the last three years and increased 2.5 times from 2013 to 2015 (see Table 17). Further, not only the total revenues have increased continuously from 2013 to 2015, but also the gross profit has grown by around 50 per cent year on year (Table 13) (Reuters, 2016).

Table 13: TMT Performance indicators - Revenue, gross profit, sales and income



(Based on data – Reuters, 2016)

The recorded sales turnover in 2013 was 420 million RMB, while the December 2015 turnover was 10,8 billion RMB (Table 17). Over the same period of time the income of TMT did not develop in the same linear manner; while TMT generated an income of 120 million RMB in 2013, its earnings fell to 70 million RMB in 2014, and reached 260 RMB million in December 2015. The reason for the drop in income in 2014 was the acquisition of Germany based ZF Sachs plastics and rubber business unit Borge Rubber & Plastic (ZF Press Information, 2013). The profitability of TMT has proven very consistent over the period of the last three years (Table 14).

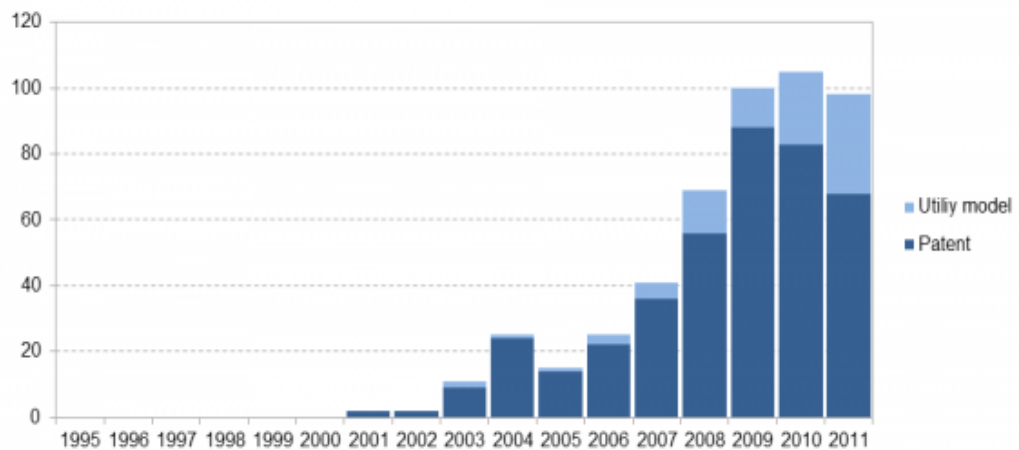
Table 14: TMT Historic Profitability overview

Profitability	12 months December 2013	12 months December 2014	12 months December 2015	3 Year Average
Gross Margin (%)	17.76	17.54	17.02	17.44
Operating Margin (%)	2.65	0.74	2.14	1.84
Net Profit Margin (%)	2.97	1.14	2.38	2.16
Interest Coverage	3.16	1.62	3.04	2.61

(Based on data – Reuters, 2016)

Patent applications are commonly used in literature to judge the levels of technological advancement a firm has achieved over the years of its development. TMT has always been striving to offer innovative products through high levels of research and development and is proudly participating in several national research projects and innovation campaigns (Zhuzhou, 2015). Looking at the below figure, TMT's first application for patents took place in 2001 and since continued to grow consistently and expanded furthermore to the application of utility models. It needs to be acknowledged that China's WTO entry in 2001 changed the overall attitude of Chinese firms for patent applications with more and more firms starting to apply for patent protection (Ching, 2003; Schüller, 2003; Cheng, 2004). However, in the case of TMT this point in time also coincided with the firm maturing on its path for technological development. This can be seen in the first big jump in applications, which took place in 2004 and thus only three years after the first patent was filed.

Table 15: TMT – Patent & Utility Model Applications by year

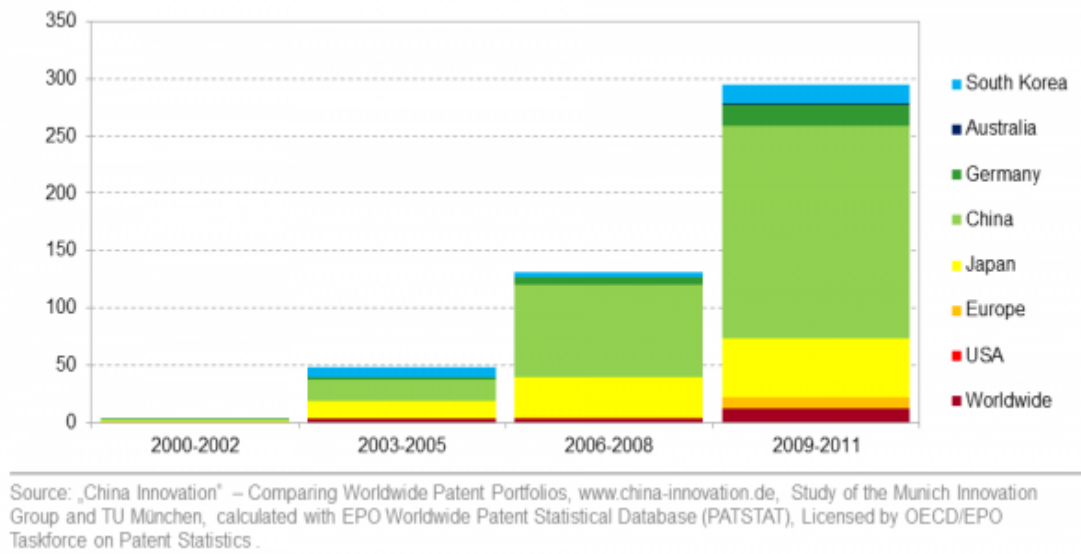


Source: „China Innovation“ – Comparing Worldwide Patent Portfolios, www.china-innovation.de, Study of the Munich Innovation Group and TU München, calculated with EPO Worldwide Patent Statistical Database (PATSTAT), Licensed by OECD/EPO Taskforce on Patent Statistics.

In the initial period from 2001 to 2008 the number of patent applications outnumbered the applications for utility models, a trend which has started to slowly reverse in 2008 (Table 15). Usually, utility model applications can be obtained more easily and cheaply, as opposed to full patent applications. The former have a shorter period of validity and a lower depth of innovation (Huang, 2003; Blancher & Rumbaugh, 2004; Yu, 2007). TMT’s ratio between patent and utility model applications still stands at a healthy 80/20 ratio and as such should not be understood as a lowered innovative output. The number of applied patents still outstrips the number of utility models that have been developed. In total, TMT had published approximately 500 patents in 2016 (Zhuzhou, 2016).

TMT has not only been applying for patents in China, but also in other countries such as Australia, Japan, or the US. This clearly shows that TMT’s innovative work is spanning beyond its domestic market. The below graphic provides an overview of patent applications by country to enhance understanding of the regional divide in innovative activities of the firm. The multitude of colours gives a good first indication that TMT has a healthy international set up in its patent applications. Already the second block in the below figure, covering the applications from 2003 to 2005 shows a healthy distribution between domestic and international applications (Table 16).

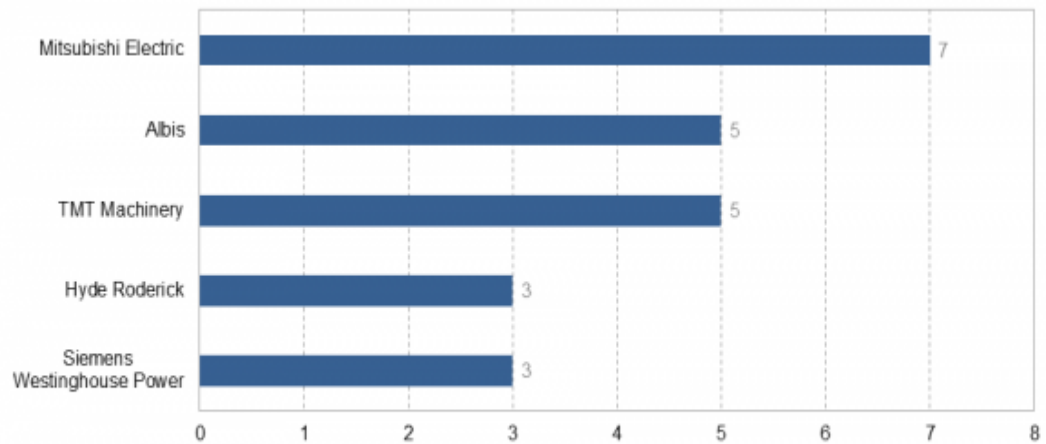
Table 16: TMT Patent Applications by Region



As can be seen in the figure above and the breakdown in countries, the overall majority of patent applications for TMT is done within the domestic Chinese market (Table 16). But taking into consideration the overall set up of TMT and that the domestic Chinese market is still the most important one for the firms, this is in line with expectations. The speed at which TMT managed to achieve the jump from domestic to international patent applications is impressive and it needs to be pointed out that they applied for numerous international patents in South Korea, Japan, and Germany only two years after the first domestic ones had been filed. Further, the share of international patent applications has been increased consistently since 2003 with the development picking up pace in the recent past.

Table 17 below shows the forward citations of the patents and utility models filed by TMT. Forward citations can be used as an indication of the worth of a patent as it shows how often a patent has been cited in other patent applications. The more often a patent is cited by other firms, the higher is its impact within the industry and the more technological value can be associated with it. TMT's forward citations for its patents and utility models are being used by such well-known global players like Mitsubishi and Siemens. Further, TMT is also citing the use of their own patents meaning that they are extending the application of the respective patent and expanding on its applicability.

Table 17: TMT – Technologically Related companies

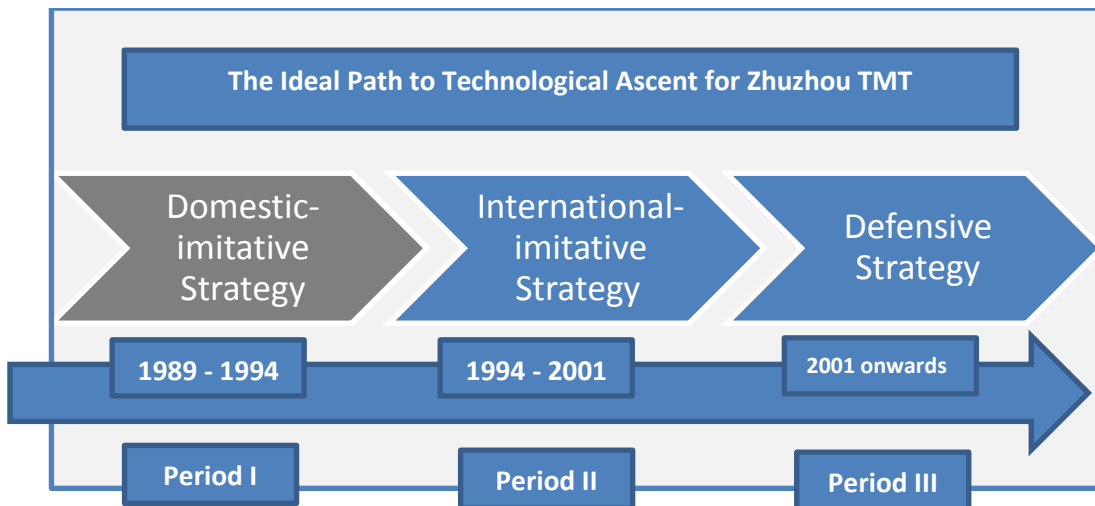


Source: „China Innovation“ – Comparing Worldwide Patent Portfolios, www.china-innovation.de, Study of the Munich Innovation Group and TU München, calculated with EPO Worldwide Patent Statistical Database (PATSTAT), Licensed by OECD/EPO Taskforce on Patent Statistics.

In brief summary, TMT has recorded an overall positive performance in sales, revenue, and gross profit figures all continuously increasing year on year up to 2011. In particular the sales and revenue development over the last three years is remarkable with both figures more than doubling in only a two years' time frame. From a technological point of view the performance indicators do look optimistic, too. Since 2001, the number of patent application has grown at a steady pace. Even though the number of utility model application has increased faster than the number of full patent applications, the overall ratio between full patents and utility models is still in favour for patent applications. This indication shows TMT's solid innovative presence in the industry, especially taking into account the international set up of applications. The next section will look at TMT's path of technological development.

5.2.5 Zhuzhou Times New Material – Development Period I from 1989 onwards

The history of TMT can be broken into three key periods of development. The first period started in 1989 when the firm was transformed from a research laboratory into an independent enterprise and developed its initial set of technological capabilities. The second key development period commenced in 1994 when TMT achieved its first key leap in technology strategy and moved from a domestic focus towards an international one. This leap goes hand in hand with TMT winning General Electric (GE) as a key customer and accessing foreign technology through being a supplier to GE. In 2001, TMT reached the historical turning point in its technological development away from an imitative technology strategy towards become an established innovative firm pursuing a defensive strategy marking the start of the third development period.



Starting with the first period of the above ideal path to technological ascent for Zhuzhou TMT it is important to understand the firm's set up in 1989 that built the rationale for the firm's choices in technology strategy. TMT had the advantage of starting in 1984 as a research institution and from its very beginning had been focused on research and in particular engineering applications of polymer composites, which gave the firm an advantage over the common, set up of state-owned firms that did not have such a strong research heritage. The firm already had initial technological capabilities in place to build on and a managerial team to support this strategy. This led the firm to be ideally suited following an imitative technology strategy rather than a dependent one. Further, in the early stage of development TMT was still too small

and insignificant to be able to capitalise on its state ownership and gain access to foreign technology via a dependent technology strategy. Similarly, for an international imitative technology strategy to be successful, TMT lacked the access to foreign technology, supplier networks, or personnel and as a result had to use domestic sources as a starting point for technological development.

Firm characteristics

The configuration of internal resources during the first period of development within TMT reflected its unique historic route of development. Due to TMT's roots being found in a research laboratory rather than a commercial SOE, the firm has a different approach towards research, development, and innovation from the very beginning. This unique set up was also reflected in the managerial team and wider members of staff, as TMT had high numbers of academics and researchers amongst its staff and a well-educated work force trained for the needs of the railway industry (Interview I). Zhuzhou's local research institutes and the nearby Railway University in Changsha supplied the required qualified workers to engage in an imitative technology strategy. From a financial point of view, TMT was well protected albeit its small size from the start of its development as it was set up under direct supervision of the Ministry of Railways and as such enjoyed direct state sponsorship. The state-ownership meant for TMT, especially at an early stage of its development, financial and institutional stability that allowed the firm to focus on its technological development (Interview I; II; VI). Or in the words of a Senior Business Development Manager:

“Money is not an issue – the inflow of cash is endless. Always has been and will be for the foreseeable future...”

(Interview, A.3)

As part of wider restructuring of the Ministry of Railway, TMT was grouped under the CSR umbrella which ensured its continued good access to financial resources. In 1989, when the research institute changed into an independent firm, the management team was mostly recruited from within the research laboratory and hence, was significantly more knowledgeable and engaged than can usually be expected from leadership teams at SOEs of that time. In summary, the overall situation of TMT at the point in

time was favourable for the successful implementation of an imitative technology strategy. The firm already had initial technology and research capabilities in place, was financially secure due to its state-ownership, had access to qualified personnel, and was managed by a knowledgeable and engaged managerial team.

National Institutions

The external resources for TMT at the time had not been consistently positive. TMT is based in Zhuzhou in the Eastern part of the Hunan province, which is a geographically remote landlocked location within China (Figure 9).

Figure 9: Map - Zhuzhou, Hunan Province in China



TMT's location has historically proven to be of advantage and disadvantage for the firm. In 1989, the remote location meant that TMT had access neither to foreign technology, supplier networks, customers, nor foreign educated employees. This was due to the focus of technological and economic development still being limited to the more affluent coastal areas of China.

“Remote locations have been, and still are, a great challenge for firms in China. Qualified labour and suppliers are often low in supply and the needed logistical infrastructure is not in place, which places challenges on the operational management.”

(External Interview, 12)

On the other side, the remote location did also mean that TMT was faced with only limited intervention from the central government whilst enjoying strong regional government support. This allowed for TMT to develop well protected from any foreign competition. Most foreign firms only started to discover the more rural areas of China as a possible sales target in the early 2000s, as the markets in tier one cities and coastal areas started to become saturated and inland locations started to benefit from the wider economic boom. One of Zhuzhou's key advantages for TMT however was its historic importance under Mao as a railway industry hub which meant good access to the domestic technology within the industry. Further, TMT benefited from an already well-established network of suppliers, readily available qualified workers, and research institutions offering access to technology.

“Zhuzhou has always played a key role in the Chinese railway industry and TMT is greatly benefitting from this heritage. In 1936, the Zhuzhou Electric Locomotive Works (株洲电力机车 - Zhūzhōu Diànlìjīchē) was founded and developed into one of the leading electric locomotive manufacturers. And the 1959 founded Zhuzhou Electrical Locomotive Research Institute founded by the Ministry of Railway is in a wider sense the origin of today's Zhuzhou Times New Materials. [...] The Railway Engineering University in Zhuzhou offers courses in almost all areas of railway manufacturing – they also have a specialised course in rubber materials.”

(Interview, A.1)

For example the above mentioned Changsha Railway University, which was merged into the Central South China University (中南大学 - Zhōngnán Dàxué) in 2000, specialised in different fields of the railway industry and provides TMT with well trained workers and engineers (Interview 1; 2). TMT's state ownership and close relation to the Ministry of Railway meant that it enjoyed strong local government support during its initial phases of development. Further, as a state-owned firm TMT until today enjoys the reputation of a good and reliable employer in the area and hence, has an advantageous position in securing qualified personnel.

“China Southern Railway is the regional employer and TMT as part of CSR has a good presence in the region – we enjoy a very good reputation as an employer – and do not struggle to fill our ranks.”

(Interview, A.5)

In 1989, TMT was still comparatively small in size allowing the firm to fully reap the benefits of state-ownership, yet not being too big and influential to be affected by the political repercussions that usually come with strong state support (Xiao & Tylecote, 2013). In the late 1980s, the railway industry itself was characterised a by growing demand in infrastructure investments and simple railway products that could cope with the outdated Chinese railway network (Renner & Gardner, 2010). The growing pace in economic development in China also created a need for more transport capacity and called for investments into the railway infrastructure. This industry environment was ideal for TMT to participate and develop its capabilities as it could compete well – from an external perspective – in a technologically underdeveloped domestic market protected from foreign competitors.

China’s railway industry as in most developing nations has been one that is under close supervision and interference of the state. It is an industry that is hard to access for both foreign and private domestic firms creating the perfect incubation space for TMT. In terms of railway components, the only real domestic competitor for TMT is CSR Qingdao Sifang Locomotive and Rolling Stock Co. Ltd. (南车青岛四方机车车辆股份有限公司 -Nánchē Qīngdǎo Sīfāng Jīchē Chēliàng Gǔfèn Yǒuxiàn Gōngsī). As far as polymer composites in railway usage are concerned TMT is the undisputed market leader in China.

Period I - Impact of firm characteristics and institutions onto firm’s technology choice

As previously elaborated both internal and external resources impact the firm’s choice in technological strategy and impact the firm’s development path for technological ascent. During the first period of development the setup of internal and external resources for TMT stayed rather consistent and changed only in an evolutionary manner, rather than a revolutionary one. Hence, the technological development

during these ten years was consistent, and both the internal and external resources remained largely unchanged.

Firm Characteristics

As far as the *firm characteristics* are concerned, TMT is an unusual case in the wider scope of Chinese state-owned firms as it developed from a research institute into a commercial firm and as such has a unique set up of internal resources. It is crucial to keep the firm's heritage in mind when looking at its development and performance on the path to technological ascent. This heritage is in particular reflected in TMT's managerial team and their overall attitude towards technology, research, and innovation. Usually state-owned enterprises are associated with disengaged external managerial leaders, who are parachuted into the firm for a set period of time and are often more guided by political rather than economic interests (Liu & Tylecote, 2009). In the case of TMT this is different, as most of the managerial team – and of its wider set of employees for the matter – are coming from a research and industry related background and therefore is highly engaged and knowledgeable in their respective field. This was of crucial importance for the firm in order to embark on the path to technological ascent via an imitative technology strategy. TMT's engaged managerial team allowed for low visibility investments that helped the firm to develop their technological capabilities and to unbundle technology and integrate learnings. Usually with SOEs there is a level of reluctance towards low-visibility investments, as any ROI will need to be captured during the tenure of the main managerial teams. As these are only with the firm for a limited period of time, high visibility investments are preferred, as they generate fast results to report to superiors. In the case of TMT, the managerial team has started its career within the firm and has been with it for a considerable length and vacancies are usually filled from within the firm. Further due to the firm's heritage, TMT already had initial technological capabilities at hand from its past as a research institution and as such did not start from zero. Most of all however the attitude towards learning and innovation throughout the members of staff and management are crucial for TMT's technological success; or as one senior manager summarised it during one of the interviews:

“One of Zhuzhou’s factors of success is its willingness to learn – always been and always will be – we have a high willingness to learn and this has helped us to become the firm we are today.”

(Interview, A.5)

This attitude towards learning goes hand in hand with the well-educated and specialised work force TMT has in Zhuzhou and allowed the firm to develop its technological capabilities. This sets TMT apart from most other state-owned enterprises; especially during the early stages of development those lacked the needed specialised workforce to grow their internal capabilities. Last but not least TMT’s financially and institutionally secure and stable operations allowed the firm to focus on the development of their technological capabilities, rather than having to worry over its day to day survival. The financial stability is a result of TMT’s state ownership which remains in place until today. The organisational stability is rooted in the firm’s practices of promoting and developing internal employees and managers that understand the firm’s long-term goals and strategic direction, allowing for a more evolutionary development. Further, the firm’s comparatively small size and technological niche back in the days meant it could develop without any significant levels of interference from neither their parent company, nor the government. In summary, the internal resources of TMT as a whole differ considerably from the ones expected in a state-owned enterprise. Especially the engaged management team and its attitude towards learning are of importance in the firm’s technology choice.

National Institutions

TMT’s interactions *with national institutions* in its initial phase of development are dominated by the firm’s inland location which during the initial period of economic development in China meant it was disconnected from the first waves of economic and technological development taking place in the coastal areas. For TMT in particular this implied a lack of access to foreign technology and supplier networks, as well as access to international employees. But the remoteness provided by the firm’s Hunan location also had its advantages in the initial period of technological development. TMT developed in the first phase of its path to technological ascent almost completely

protected from foreign competition. Moreover, the particular geographic location of TMT in Zhuzhou also proves to be a significant advantage for the firm, as Zhuzhou is a traditional railway industry hub within China. Being based in Zhuzhou allows TMT good access to existing domestic technologies, supplier networks, and qualified personnel.

“Zhuzhou has is of great historic importance for the Chinese railway industry. A history which goes back to Mao times, when important industries been re-located into remote areas to protect them in case of any external aggressor invading China.”

(External Interview, 20)

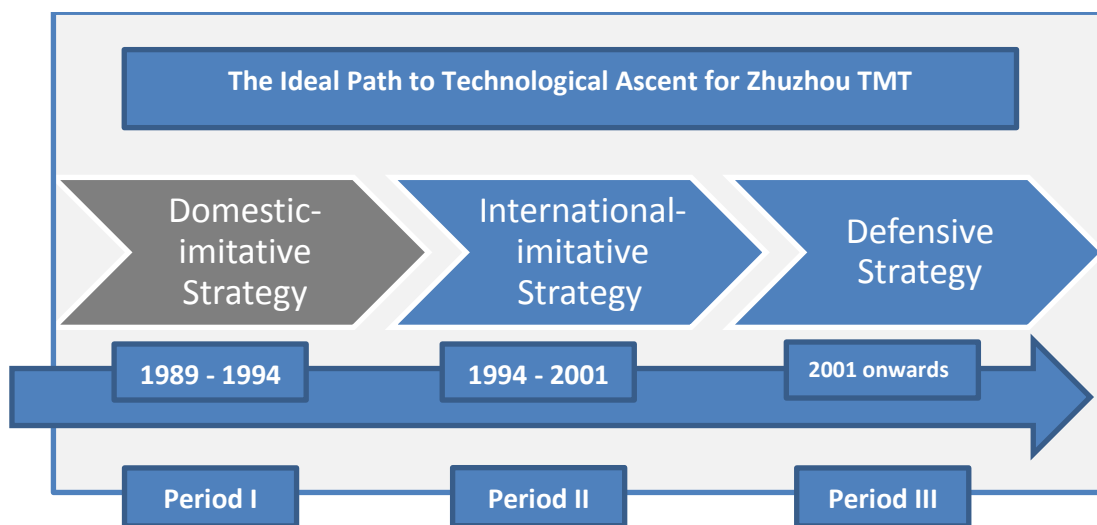
The railway industry in China, as in many other countries worldwide, is associated with high levels of government involvement (Renner & Gardner, 2010). This is due to its national importance and the size of investment in railway projects. Often this is also reflected in high levels of national protectionism. In the case of TMT these protected the firm from international competition during its early phase of technological development. This sort of protection bought the firm additional time to develop their technological capabilities in order to catch up with foreign lead firms through an imitative rather than dependant technology strategy. Yet at the same time, the Chinese Railway industry in the early stages of the Chinese Economic Reform offered considerable demand and growth potential for TMT, as the Chinese railway infrastructure was in need of updating and expansion (Renner & Gardner, 2010). This need for inexpensive and technologically simple railway products provided TMT with a large domestic market to sell to in absence of foreign competitors. Also domestic competition was only limited as access to the market is strictly regulated by the government. As far as the national institutional environment is concerned, TMT combined the best of both worlds by being state-owned, and as such being able to access the associated benefits and advantages, while being too small in size and specialised to be subject to significant political interference into its economic and technological decisions. Further, through its association with the Chinese ministry of Railway in the beginning of development, TMT always was ensured privileged access to financial resources, state support, and markets.

Technology Strategy

TMT was isolated from foreign technology – yet equally from foreign competition – and was in the possession of both good internal and external resources to tackle the challenges of technological ascent. In this very particular set up TMT enjoyed the needed levels of support and protection at an early stage of development through its close ownership ties to both regional and government entities. TMT had the ideal starting point to pursue a domestic-imitative technology strategy as it had a good set up of initial resources needed for a more challenging imitative strategy. These include: an engaged managerial team, access to technology, and protection from foreign competition. While at the same time the growing railway industry offered enough growth potential for further development and the state ownership ensured the firm had sufficient funding in place to cope with the needed investments and the delayed ROI of research and development. The following development period from 1994 to 2001 was characterised by TMT's technological development moving away from a domestic focus towards a more international one. During this seven year period TMT managed to emerge as an internationally operating firm with a solid base of technological capabilities.

5.2.6 Zhuzhou Times New Material Technology – Development Period II from 1994 onwards

The first development period of TMT ended after ten years in 1994 and was followed by the second development period, which lasted until 2001. During these seven years TMT managed to become an established provider within the international railway industry for polymer composite products. It did so with a strong research base and set of technological capabilities. Furthermore, it managed to successfully shift its technological strategy from a domestic-imitative one, towards an international-imitative one; achieving progression by one step on its path to technological ascent.



This change in strategy to an international initiative technology strategy, was not a result of an evolutionary process, but rather the result of a revolutionary event that prompted the firm to reconsider their choice in technology strategy. In 1994, TMT secured GE Electric as a customer. This achievement fundamentally changed the firm’s outlook on technological development and boosted its technological capabilities in the following years. Or as one of TMT’s senior managers phrased it:

“A real turning point in TMT’s history is the cooperation with GE – they supported us very much over the years – especially in the early stages of our development. We have learned a lot over the years from GE since they took us on as their supplier.”

(Interview, A.5)

GE’s choice to take TMT on as one of their suppliers, as well as their support during the initial stages of the cooperation, allowed TMT to access foreign technology that had so

far been out of reach for the firm. The changed set up in resources within TMT triggered the reconsideration and allowed for a successful pursuance of an international-imitative technology strategy. The following section will discuss the internal and external resources during this period in more detail.

Firm Characteristics

During the first period of technological development, TMT had a chance to develop its initial – more rudimentary – technological capabilities in an industry well protected from domestic and foreign competition. As previously discussed, this was to a large degree possible due to TMT's unusual set up as a research institute with a unique learning attitude. For example, TMT at a very early stage in development started experimenting to create their own rubber mix – a step that is usually outsourced by firms like it – allowing TMT to offer better quality plastic products.

“From our early days, we started doing our own rubber mixing – something most of our competitors have outsourced to 3rd party providers – but we do it ourselves to get a higher quality product. This way we do not have any transport involved as the rubber is mixed on site and we can ensure the mixture is not being damaged during transport.”¹

(Interview, A.1)

These initial technological capabilities and TMT's unique attitude towards learning were of great help for the successful implementation of an imitative technology strategy. Once TMT secured GE as their first foreign key account it was able to access foreign technology and move upwards the ideal path for technological development from a domestic imitative to an international imitative technology strategy. TMT becoming a GE supplier was a break into international technology. Up to this point, due to the remote location of the firm, it still struggled for technology access. Zhuzhou being a third tier with – back in the days – it had little exposure to the market opening of coastal areas and its associated inflow of foreign technology. GE strongly supported TMT in its set up as a certified supplier and by doing so levelled the way for TMT to secure other foreign firms as customers.

¹ The interviewee stated that the rubber mixture is prone to temperature fluctuation and can become damaged in transport which influences the quality of the end product.

“Securing GE as a customer was a great break for TMT. With a leading Western firm on board we become an option for other leading firms, too. GE put us on the map within the international industry as a reliable quality supplier.”

(Interview, A.6)

“GE selected TMT as a supplier as part of their wider China sourcing strategy – once TMT had been certified it helped to establish our firm as an international supplier beyond the borders of China.”

(Interview, A.2)

In the early 1990s, GE started to develop a new sourcing strategy. They endeavoured to find cost saving opportunities based on lower overall cost structures, in particular in terms of labour costs. GE focused their search on China for the above reasons.

It was then their different attitude as an US American company that made them follow through with their strategy. European firms at the time had been significantly more concerned with quality issues and the dangers of sharing technology with Chinese suppliers than their American counterparts. However, for GE the anticipated cost savings had, combined with their willingness to provide initial technological support to supplier firms to overcome quality issues, overruled these concerns. In the words of one of TMT’s Business Development Managers:

“It was the different attitude of the Americans back in the day that brought them to China. For the Americans cost-saving is key – even today we can see a difference in attitude between our US and European customers.”

(Interview, A.2)

“The “made in China” stigma is less relevant for the US market, more so in European markets, and especially in Germany which is still is rather hesitant to fully embrace Chinese suppliers. It all depends on the sourcing strategy of the customer – Americans are more aggressive, while German firms are more conservative².”

(Interview, A.1)

For GE cost savings were key. Hence, they wanted to profit from TMT’s cheap production costs and in return were willing to offer strong support to TMT in its technological development such as: technology transfer, training of manufacturing and engineering personnel, and support in quality control. For GE, this went so far that they even encouraged and not just accepted, certain levels of reverse engineering on the technology provided:

“A certain amount of reverse engineering was actually encouraged by the foreign customers – to at least a degree – in order to meet their quality and product standards. The reason to do that: they want to cash in on the possible cost savings. “

(Interview, A.2)

GE’s willingness to share their knowledge and active encouragement for TMT to unbundle the technology, jointly with TMT’s willingness to learn set the founding stones for the firm’s successful technological ascent.

TMT’s parent company CSR has been of limited use for the firm as a source for technology. The engineers of CSR and TMT cooperated closely, however, the TMT engineers were the experts. Hence, it was them educating their CSR colleagues, rather than the other way around.

“CSR and TMT engineers do cooperate in their development but the learning goes the other ways round – TMT is the expert in their field (of polymer composites), and not CSR.”

(Interview, A.3)

² TMT’s products are used in dampers and dampening systems of railways and railway coaches, even though the components itself are not classified as security relevant as such, they are integral part of the dampening and suspension and these as a whole are considered security relevant components. This seems to be a significant reason for European firms to more hesitant according to several interviewees.

CSR only had a very limited technological input towards TMT's technological skill set, while TMT itself enjoys a good technological reputation within the wider CSR organisation. As a TMT senior manager explains it was cash rather than expertise that CSR brought to the table:

“As far as technology is concerned there is very limited input from the side of CSR, but they do bring substantial amounts of cash.”

(Interview, A.6)

This is also an indication for why TMT could develop its technological strategy mostly uninterrupted by its mother cooperation, as they are seen as experts and the decision process is left mostly to their senior management's discretion. As previously mentioned in the section discussing TMT's governance structure, the firm's management team is very knowledgeable and educated in their respective industry. This is particular unusual if compared with other state-owned firms that often lack deep industry insights and knowledge backgrounds (Leutert, 2016). The detailed biographies of the management team can be found in the appendix of this work and illustrates that most senior managers have progressed through TMT's ranks during the course of their career. The example of the General Manager of Zhuzhou Times New Materials, Jun Yang, has been discussed in the governance structure section of this case and is *vita* is rather the norm than an exception within TMT.

“It is not uncommon for employees – workers as well as managers – to join our firm and stay on for life. That is one of the main differences working for a state-owned firm (rather than a private owned firm).”

(Interview, A.10)

The above statement usually is true for workers but for senior management in a state-owned enterprise this is rather unusual. In particular in combination with the high levels of education and industry experience, which allowed TMT to invest into unbundling and learning as the senior management understood the importance of the undertaken investments for the future technological advancement of the firm. These

levels of understanding are not common for many state-owned firms, as they usually lack devoted management and industry expertise these provide (Leutert, 2016). Further, it needs to be mentioned that the state-ownership of TMT comes with an advantage over privately owned ones. TMT's comfortable financial situation allowed the management to initially undertake low visibility investments, without having to worry too much about their financial results. The strong financial support given by the parent company CSR to TMT has been consistently mentioned through all interviews and is in line with the theoretical expectations raised in the literature.

In summary, the technological breakthrough as far as internal resources are concerned was partly rooted in gaining access to foreign technology through becoming a supplier for GE, and partly in the well-educated and insightful senior management that allowed for the unbundling of the obtained technology. Further, TMT already had the needed basic technological capabilities at hand to build upon and to integrate the foreign technology into. The next section will look at the external resources of TMT during the second period of technological development.

National Institutions

TMTs external resources in terms of geographical location did not change during the ten year time period of the first technological development period. Being far detached from the booming coastal areas of the early 1990s, TMT's remote location in a third tier city did negatively affect the firm's access to foreign technology. Moreover, for the same reason international supplier networks and internationally trained employees were harder to access for the firm. This negative effect weakened over the course of China's economic opening, however, they have not been fully levelled out compared to more developed coastal areas even today.

The remote location did, however, also have its advantages for TMT's development. The cheap labour and overall cost structure was instrumental to the firm in securing GE as a first internal key account and by doing so pushed the firms' technological development onto the next level. Further, Zhuzhou albeit remote in its location, has always been a railway technology hub; including under Mao. As such, it allowed TMT good access to domestic research institutes, industry focused universities, and supplier

networks. While in the initial development period this was important to the firm for access to domestic technology, during the second period it benefited the firm particularly with regards to accessing supplier networks and qualified personnel. A seasoned member of the management team phrased it as follows:

“Zhuzhou Times New Materials is one of the key regional employers with a great presence and reputation that can offer above average payment and work place security. This allows us good access to the labour market and helps us to secure the talent we need. Zhuzhou has always been a solid parameter in the Chinese railway industry [...]”

(Interview, A.10)

According to the interviews conducted TMT, contrary to other state-owned firms, at no point in time faced real troubles to recruit qualified workers or engineers to support their technological development. The Changsha Railway University and several railway related research institutes supplied TMT with the needed personnel. Further, the remote location means that fewer firms, domestic and international ones, compete with TMT for qualified employees. This keeps the levels of employees retained high, helping TMT to build the company culture and retain technological knowledge. In addition, the rather remote location allowed the firm to develop away from central government interference. Central government officials were only rarely sent to remote locations and focused their actions on the more prominent coastal regions. Again, this allowed TMT to develop an engaged management team modelled closer to that of private owned firm, rather than a state owned one.

Its ownership structure influenced TMT’s growth substantially during the second period of its technological development. A lack of access to financial resources is a common problem for developing domestic Chinese firms as it hinders their ability to pursue technology strategies that involve a delayed return in investment. TMT though, enjoyed privileged access to finance through its state ownership and parent company. As such it could focus on its technological development without having to fund these investments solely from their operating profits. Or as a foreign employee summarised the firms’ attitude:

“Being state-owned enterprise money has never been an issue for the firm. In Western firms products and technology are a mean to generate income, while for TMT it is more about proving something or solving a technical challenge, rather than making money. It is hardly ever a matter of discussion and certainly not one of priority.”

(Interview, A.1)

Beyond its monetary benefits, state-ownership helped the firm to maintain close relations to local and regional state authorities. This helped facilitated for the firm to operate in an institutionally secure environment. During the interviews the connection between TMT and the local and regional government was mentioned as being of a positive nature. One manager did elaborate:

“TMT is a key employer in the region and enjoys good relations with the local government. We regularly participate in regional and national innovation campaigns and won several prizes such as the: “National Torch Plan Key High-Tech Enterprise” and “High-Tech Enterprise of Hunan Province”.

(Interview, A.7)

“Being a SOE of any kind has been of great advantaged in earlier days of the economic development in regards to access to the financial system. Access to capital through the banking system was no problem, especially for investments into technology.”

(External Interview, 8)

Given TMT’s historically close ties to the Chinese Ministry of Railway, it is not a great surprise to see TMT’s close and good relationships to all levels of government. The state-ownership furthermore opened the door for TMT to a wider network of railway related firms in the area. In detail, these different state-owned enterprises in the same industry closely cooperate under the roof of the Zhuzhou Railway Research Institute. This includes the exchange of technological knowledge and the running of joint R&D and training projects. Access to this group of firms is only possible via good government relations and is not commonly given to privately owned firms. Fortunately, according to the Zhuzhou Railway Research Institute, TMT’s ownership

structure is a good example for the type of state-owned firm that can gain access to the group.

In 1994, TMT in regards to its size was still small and insignificant enough – in a wider scope of the Chinese railway industry and its leading firms – to fly under the radar of central government’s attention. Central government interference into technology development of certain sectors in China usually leads to firms moving away from imitative technology strategies and unbundling the respective technology towards a dependent one. The goal behind this is to generate fast results in the technological advancement of the end product. The automotive industry is often used as a common example of the failed industry policies to boost technological capabilities in certain industry sectors within China (Harwit, *China’s Automobile Industry: Policies, Problems and Prospects*, 1995). However, from a local point of view TMT was still big and influential enough to be considered as important locally. Hence, it was able to secure the local and even regional state support necessary for its development. TMT’s comparatively small size and the associated struggle for survival were counterbalanced by TMT’s state-ownership. CSR as a parent company provided TMT with enough financial backing to endure the slow return of the low visibility of technology unbundling. Further, the stable financial and institutional set up allowed TMT to be in a competitive position to cope with a global key customer, such as GE, and meet their supplier requirements. Especially the aspects of stability had been important to secure GE as a customer, as it limited the levels of risk for the American company in investing into the training and support for TMT.

In the early 1990s, the Chinese railway industry had managed to achieve the initial catch up in the growing needs for transportation and infrastructure during the reform period. By the mid-1990s the Chinese government started to change its focus from merely building infrastructure to increasing quality of transportation by investing into high-speed railway networks. This meant for TMT that the industry volume was growing and it was faced with a strong domestic demand that funded its operations. Further, being a state-owned firm in a strategic pillar industry (Chinese: 支柱产业 – Zhīzhù chǎnyè) TMT enjoyed great benefits with regards to market access and protection from competition. This aspect rose to particular importance during this

second period of TMT's technological development. Would it not have been for these benefits, TMT would have faced strong competition from Western firms. However, since the Chinese government strictly regulated the access to any sector of the railway industry, TMT remained protected from direct foreign competition that would have taken place in any other open market. Even in the late 1990s foreign firms were still limited in accessing the Chinese railway market and were forced into joint ventures with either CSR or CNR (China Northern Railway). For example, Bombardier and Kawasaki Heavy Industries joined CSR in joint ventures, whereas Alstom and Siemens partnered with firms belonging to CNR (Table 24). TMT's parent company proved to be beneficial to TMT, as they could learn from these alongside their parent company. Having a head's start already as an experienced supplier for GE, this helped TMT greatly on the path to technological ascent.

Period II Summary - Impact of firm characteristics and institutions onto firm's technology choice

Firm Characteristics

The defining turning point for TMT during the second period of technological development was securing GE as a lead customer and GE's strong support to establish TMT as a supplier. By introducing more advanced foreign technology that TMT was able to unbundle, TMT was able to transform its technological capabilities, which so far had been largely based on the domestic technology available. This had a cascading effect on how the firm was perceived within the wider industry. Once TMT started supplying GE with quality products, it was recognised by other international firms such as Bombardier and Siemens as a capable supplier. Both Bombardier and Siemens joined TMT as lead customers in 1998 – four years after GE started its cooperation and sourcing strategy in China (Bloomberg, 2016). TMT had managed to successfully utilise the technological expertise gained during their first period of technological development between 1984 and 1994. Further, it had managed to integrate the newly accessed foreign technology into the existing set of technological capabilities. The cooperation with GE was a great technological push for TMT, as it not only managed to obtain access through this cooperation to foreign technology and clients, but also was able to quickly unbundle and reverse engineer the technology.

“Securing GE as a customer was a great break for TMT. With a leading Western firm on board we became an option for other leading firms, too. GE put us on the map within the international industry as a reliable quality supplier.”

(Interview, A.6)

“GE selected TMT as a supplier as part of their wider Chinese sourcing strategy – once TMT had been certified it helped to establish our firm as an international supplier beyond the borders of China.”

(Interview, A.2)

GE was motivated to support TMT in order to capture the cost advantages that were rooted in TMT’s location advantage. An advantage which had been even further strengthened due to its rather remote inland location, that comes with lower wage levels as in the more affluent Chinese coastal areas, while the comparatively good infrastructure of Zhuzhou can compensate any additional transport needed to reach coastal harbours.

“Most of our products are moved containerised to our customers; meaning we are loading the containers onto trains and move them to the harbour for sea shipment – very little cargo moves via air freight due to the high costs. Zhuzhou’s history (as a railway industry hub) gives us a great advantage as we can rail products to various sea harbours depending on our final destination.”

(Interview, A.3)

National Institutions

Zhuzhou’s historic background as a railway hub, mentioned in the above quote, not only comes with logistical advantages to TMT, but also brings access to qualified and industry trained labour, domestic technology, research institutes, and supplier networks. All these aspects have been crucial for TMT to overcome the usually associated disadvantages of a remote landlocked location in China and they link to both external factors of industry and location. TMT would not have been able to utilise and benefit from Zhuzhou’s location advantages to the same extent would it have

been operating in a different industry. Clearly Zhuzhou's railway heritage strongly supported TMT's success on the ideal path to technological ascent.

Further, its state-ownership for TMT means that they are supported by considerable financial and institutional backing, especially during this challenging time of technological catch up. The resulting financial and institutional security allowed the firm to solely focus on the development of its technological capabilities, while not having to worry about monetary aspects. This aspect did also help to secure GE as a customer. Since GE supported TMT for the initial period of the cooperation, it was of importance for GE to know TMT will be a reliable and stable partner for the future to come, as GE invested time and money to support TMT in order to reap the benefits through its supply chain in the years to come.

"I do not think that TMT's ownership structure matters in these days – it is not a sales argument, nor does it affect sales – but it was in the early days. People knew that there is backing behind the firm and TMT is not just a small producer of parts in the middle of China [...]."

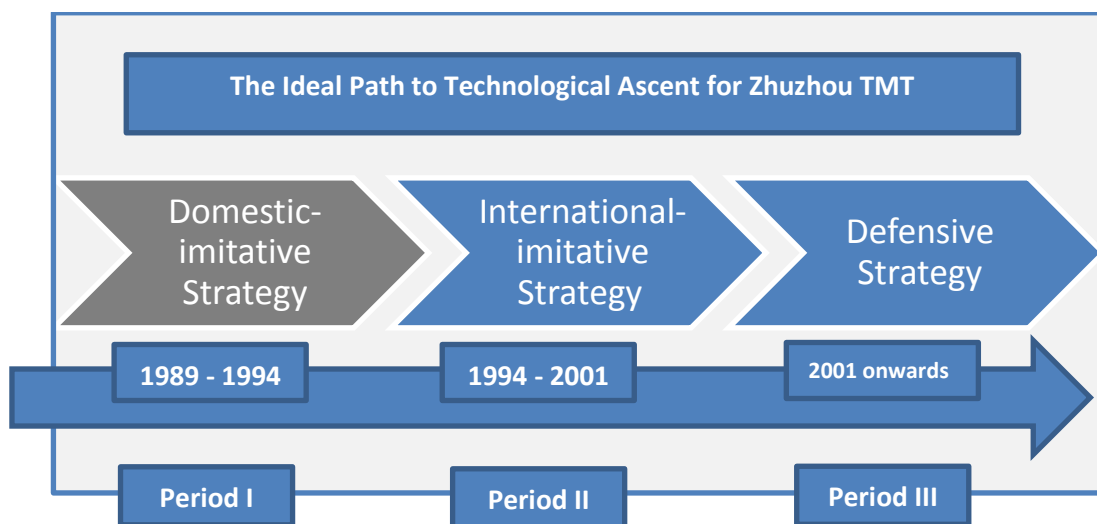
(Interview, A.5)

Technology Strategy

The second phase of TMT's technological development fell into the same time frame as the launch of the first phase for the Chinese railway industry development plan that was promoted by the central government. The Chinese railway industry development plan started with initial studies into the railway industry being conducted by the Ministry of Railway in 1991. Its focus was to build the Chinese railway industry into a state-led pillar industry; run by the Ministry of Railway and key SOEs, through the import of foreign technology and domestic capability building (Zhe, 2015). Being a state-owned firm, TMT was in a wider sense part of this program and enjoyed yet stronger state support during this period. However, it needs to be again stated that due to TMT's wider position in the CSR organisational structure and its remote location, it was not directly impacted by central government interventions, but rather benefited indirectly through the overall growth in the market triggered by this development policy.

5.2.7 Zhuzhou Times New Material Technology – Development Period III from 2001 onwards

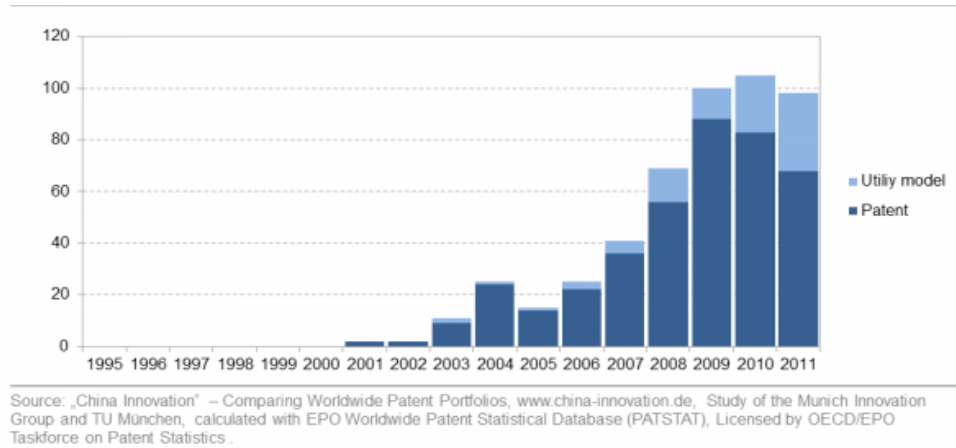
With the new millennium, TMT started to move away from an international-imitative technology strategy and since 2001; TMT now pursues a defensive technology strategy. This new technology strategy marks the third period of technological development for TMT, which is on-going to this day. This change in technological strategy is a key event in the firm’s ideal path to technological ascent, as it marks the successful transformation from a company unbundling and imitating technology, to a company that applies its capabilities into original innovation. In summary, TMT ascended from being an imitating firm, to being an innovative firm.



This process was, opposed to the technological shift between first and second development period, not of a revolutionary, but rather evolutionary nature. The change cannot be directly attributed to a landmark event in the firm’s history. However, the year 2001 stands out in the technological development path of TMT as the year where it filed its first patent applications (table 18). These first patent applications can be interpreted as a sign that TMT had technologically matured and needed to protect its own technological achievements from imitation of other firms in the sector. It can be argued that China’s WTO entry in 2001 did spark the patent applications of the firm. With entering the WTO the awareness in China for IPR and the need to protect it through patent applications was raised significantly (Huang, 2003; Blancher & Rumbaugh, 2004; Yu, 2007). While below data on TMT’s patent

applications show that TMT did not start to apply for significant numbers of patents until the year 2003, this study nevertheless argues that these first applications from 2001, jointly with joining the WTO, signify a change in TMT’s strategy to a defensive technology strategy already.

Table 18: TMT - Utility and patent applications by year



The above graphic of patent and utility model applications by TMT gives a good indication of the firm’s technological development pace; between 2004 and 2010 TMT doubled its number of patent applications every two years. From 2009 around 100 applications have been submitted each year and by 2011 TMT had filed approximately 500 patent and utility models.

Firm characteristics

The first and second period in TMT’s path of technological development had primarily been characterised by the firms need to close the technological gap between itself and industry leaders. By the start of the third period these technological challenges had been partly overcome and the focus shifted to a wider set of characteristics TMT required to be successful.

In part this shift in focus can be attributed to the change in TMT’s managerial team. As the initial set of Chinese educated managers and engineers retired, they were replaced by a younger generation of managers, who were more exposed to Western ideas and managerial concepts. An example, the current managing director, Mr. Yang Jun, came into power in 2009 at the age of 36 with having joined the firm directly from university

where he obtained a PhD in Polymeric Material Sciences. Even though none of the managerial team as of yet holds a degree from an overseas university the biographies of the managerial team indicate a change in exposure to Western management ideas. Moreover, the deputy general manager of TMT, Mr. Li Xiaoyong, has previously been the general manager in a Zhuzhou based joint-venture of Siemens, directly exposing him to the management of a western company. This generational change in management was an evolutionary, rather than revolutionary process and has impacted the management of TMT throughout the third period. This new generation of managers is challenging existing organisational structures within the firm and try to not only push the technological development of the firm, but also the organisational one. The later in particular is challenged in terms of efficiency.

“We need to reconsider our organisational structure to allow for innovation beyond technology. Neither the incentive to work hard is given, nor to promote a reduction costs. Our sales people are not even commission based, for example – in what normal world are sales people not commission based”

(Interview, A.7)

The above stated quote is a good example for the organisational challenges TMT is faced with. They are partly rooted in TMT’s state-ownership and its heritage as a research institute. But the new managerial team is acting on this challenge, which is reflected in several areas of the firm. For example, TMT’s new approach to HR policies includes the performance evaluation of employees based on a concept jointly developed with Western consulting firms. The aim is to overcome the above stated lack on incentives. The performance evaluation is also the basis for salary reviews and promotions and is implemented throughout the firm from the shop floor to management.

“The payment structure of the employees is consistent from manufacturing through to administration and management; it consists of three parts: personal competencies, job responsibilities, and performance assessment.”

(Interview, A.2)

During this third development period TMT started to focus not only on their technological capabilities, but also on their wider firm capabilities and how to improve them. Historic internal structures that are naturally grown over centuries cannot be changed overnight and this again is a rather evolutionary process that takes time to come to fruition. However, the management of TMT has acknowledged these shortfalls and, similar to their technological need for support, have started to seek external support for their organisational challenges by reaching out to Western consulting firms. As in previous phases of development, the new generation of managers is still closely linked to the industry and has a good understanding of market needs and changes. For example, TMT is slowly moving away from being solely a component producer for the railway industry and towards offering servicing packages to existing railway, tram, or underground networks.

“Our usual clients are rolling stock producers, both Chinese and international ones. But we are also selling to smaller firms as part of maintenance contracts. Or, we offer these (maintenance) packages ourselves; either as part of our after sales efforts, or as a standalone product.”

(Interview, A.8)

Throughout the different phases of technological development in TMT’s history the firm constantly increased its technological capabilities through continuous learning. During the first period, it learned from domestic sources, while in the second period the main source for learning had been foreign customers as an external demand driver, first and foremost GE. In 2001, this longstanding cooperation as a supplier to several Western firms has generated considerable learning effects for TMT and has reinforced its technological capabilities. Further, through the second period of technological development TMT established an extensive network of suppliers for their operations, who have grown alongside TMT.

“Most of our suppliers have been working for TMT for many, many, many years. The relationship between these suppliers and us has grown over the years and is of mutual

trust and benefit. Most of our suppliers are locally based in Hunan, but we also have suppliers based in Jiangsu and Hubei provinces.³

(Interview, A.3)

These longstanding supplier relations allow TMT to offer quality products at competitive rate levels. They helped the firm to keep its overall cost structure lean in order to compete in the market. As the firm developed along the ideal path to technological ascent the matter of quality has become increasingly important for TMT.

“Our customers have high demands on quality and we are committed to meet and excel these demands in our products, especially since many of our products are part of safety relevant components. This commitment to quality and expectation in regard to quality is handed down to our suppliers as well – we expect them to meet these with no exception and to run quality audits to ensure the quality is up to our standards.”

(Interview, A.2)

“We outsource certain parts of our production to external suppliers. These are usually local suppliers and we run standard quality audits to ensure their targets. [...] Nowadays there is very little need to particularly train our suppliers; we run our usual quality audits and it is for the supplier to ensure the requirements are met.”

(Interview, A.3)

“Working for TMT as a supplier is a batch of honour in the area – if you work for TMT it means you also work for GE, Bombardier, and Alstom in a way – meaning you have these names on your customer list as a signal to prospective customers that your product is of high Western standards.”

(Interview, A.1)

Further, the domestic customers have been a driver for technological learning within TMT during this development period. As TMT’s domestic customers have raised their profile, they raised their requirements to their suppliers as well. Hence, not only the

³ Asked for the ownership structure of suppliers, interviewees stated that they are a mixture of both state-owned and private-owned firms. Suppliers are chosen by the quality of product/service offered, rather than ownership type. According to several interviews there is no SOE conyism.

firm’s foreign customers have high expectations in the quality of products, but also the domestic customers are expecting and demanding higher quality products, as their products have changed, too. While in the early 1990s Chinese railway manufacturers produced slow and outdated railways and railway coaches, by the 2000s the domestic industry had changed completely to a strong focus on high-speed railway. This shift had also impacted TMTs business and products. The below table gives an overview over the development in Chinese railway technology, which clearly shows the jump in technology between the first generation of trains in 2005 and the second generation trains in 2009:

Table 19: Technology Transfer: Chinese High-speed Railway Joint Ventures

Technology Transfer: Chinese High-speed Railway Joint Ventures	
CRH 1: Bombardier & Sifang (CSR)	<ul style="list-style-type: none"> • JV established 1998 • First generation train with top speed of 155 mph (2005) • Second generation train with top speed of 236 mph (2009) • Build in Qingdao, Shandong province • Engineered in Europe
CRH 2: Kawasaki & Sifang (CSR)	<ul style="list-style-type: none"> ▪ First generation train with top speed of 155 mph ▪ Second generation of trains with top speed of 217 mph (2009) ▪ First nine train sets been produced in Japan ▪ Now entirely produced in China ▪ Joint Venture ended in 2007 – second generation train a CSR own development
CRH 3: Siemens & Tangshan (CNR)	<ul style="list-style-type: none"> ▪ Derivate of the Siemens Veleo trains used in Germany, Spain, and Russia ▪ Top speed 217 mph ▪ First three train sets produced in Germany ▪ Now produced locally, with Siemens supplying key components
CRH 4: Alstom & Changchun (CNR)	<ul style="list-style-type: none"> ▪ Closely related to Alstom’s Pendolino design ▪ Top speed of 155 mph

TMT management at an early stage acknowledged the importance of quality as a sales argument and the need to display quality and innovation to its customers at any chance they had. As previously discussed in the second development period, the so-called China stigma is an issue still for TMT - even during its third period of development. According to several sales managers of TMT their products are still sold mostly based on price, rather than quality, as TMT continues to struggle to be perceived as a high quality supplier.

“Our main sales argument in the market is still price over quality. We struggle to beat Western firms on the perception of quality, but we can beat them on the price.”

(Interview, A.8)

“Our products are of good quality and standard – we have high levels of quality control in-house, in line with industry standards – and by my perception our quality problems are in line with other producers in the market.”

(Interview, A.5)

Especially in markets where more conservative sourcing strategies are in place, TMT is struggling to overcome prejudice with regards to the quality of its products. For this reason, the management of TMT decided to invest into a state of the art testing facility, which allows for rigorous in-house testing of a wide multitude of scenarios. Examples include: fatigue testing, speed testing, or vibration testing. The testing facility has been sourced from Lord Cooperation, a well-established US technology and manufacturing company. The testing facility is not only one of the best equipped testing facilities in Asia, but also is TMT one of only a few firms worldwide that can claim sole access to such an extensive testing facility. Most firms do share these kinds of testing facilities due to the high costs associated with them, but within TMT all kinds of testing are readily available.

“The testing centre is the best in Asia and state of the art!⁴ We can offer almost every industry testing required in-house with no waiting time required. We have full direct access with any possible testing scenario on our door step. Plus, we can provide our customers with a full testing report, which is something only few suppliers can offer to their customers.”

(Interview, A.3)

One interviewee quoted a Western auditor who came to Zhuzhou to supervise a series of tests in Zhuzhou who commented not without envy on the testing facilities:

⁴ During an informal talk I had the chance to talk to a manufacturing consultant, who is familiar with the testing facility and who was able to confirm that the test centre is in fact state of the art. The interviewee statement is, hence, not sparked by the Chinese fondness of superlatives, but is accurate.

“These kinds of machineries are developed and produced in the Western world, but nobody buys them there!”

(Interview, A.5)

His comment was aiming at the high costs associated with such an elaborate testing facility and the vast numbers of test available to TMT at their fingertips⁵. Further, it needs to be mentioned that although TMT bought the testing facility in large parts from Western suppliers, they have been developed further it to meet specific testing needs. This has in large parts been done in close cooperation with national universities, which are a pool of talent for engineers.

“The testing machinery has been bought in the West, but we have been continuously developing the machinery and devised new test setups as we work closely with a variety of Chinese universities to support us in this.”

(Interview, A.5)

TMT enjoys a good reputation as an employer offering a secure job at above average pay and in a well-respected firm. Further does the firm offer substantial additional benefits to its employees, such as: a car allowance, mortgage support, paid mobile phones, health care support, regular gifts, and additional social benefits like health clubs⁶. Most privately owned firms are not in a position to offer such substantial benefits to their employees and hence, are in an unfavourable position to attract talent in the labour market.

“The working benefits provided by TMT are great and stand out in comparison to other firms in the city. There is for example an offer for mortgage support – I think it is around RMB 2000 per month – this might not sound much, but is of great help to many buying a flat; and owing your own flat is important in China. [...] The benefits are surely one aspect why we have a good reputation as an employer.”

⁵ A selective list of testing machinery available to TMT can be found in the appendix.

⁶ Regular gifts given by TMT can come in all forms. These include: vouchers, special offers through associated partners, electronic items, or even food. A foreign employee of the firms expressed her great surprise when she came to work one morning to find a 40kg bag rice propped up her desk. “It was not that I was ungrateful but you try moving a bag of rice away from your desk so you can sit down that is almost as big as you are.”.

(Interview, A.5)

“If you take into consideration that an average sales employee earns around 500 to 800 US Dollars per month these benefits do start to matter. And TMT offers a lot of them from subsidised food to health care, over phones, the list is endless. Not even foreign firms in the big cities offer such substantial benefits.”

(Interview, A.1)

These substantial benefits and the above average pay allow TMT to secure the best talents within the regional labour market and TMT can even stand its ground in the national one.

“Due to the good pay levels and benefits TMT can attract talent from all over China. It is worth noting that in many coastal areas prices, especially real estate, have grown much faster than wage levels, making it harder for young people to make a living. In Zhuzhou prices are still lower and people can live comfortably from their income.”

(Interview, A.7)

However, TMT does struggle to find suitable talents on the international labour market, which is becoming more and more of a challenge for the firm as it is trying to expand. It is especially their international business unit that is affected, as the department is dependent on foreign work force. The reason for TMTs struggle to obtain foreign workers is mostly rooted in its location. With Zhuzhou being a third-tier Chinese city it has less exposure to Western influences as the bigger cities at the coast. In mid-2014 TMT employed eight foreigners within their organization, all of which worked in the international business unit. In a follow up interview with one of the senior sales managers in early 2015, it was confirmed that four of these eight had now left the company.

“It is always challenging to work in a foreign country – there is a level of cultural clash – but at some point, you will get the hang of it and fit in. In China however, you will always be a foreigner and that is irrespective of your language skills due to the greater cultural divide. [...] Living in a third-tier city calls for sacrifice in your lifestyle and social life. The madness of everyday life in Zhuzhou can get to you at some point.”

(Interview, A.3)

TMT has acknowledged the problem and its impact on especially their international business unit. It is trying to be more proactive in attracting foreign potential by increasing their presence on Western job websites and job fairs.

National Institutions

The external resources available to TMT during their third development period, in particular with regards to location, did change in comparison to the second development period. The Zhuzhou of 1994 stands in stark contrast to the one that could be found in 2001, and most certainly to the one of today. The location advantages for TMT stayed the same as previously mentioned during the earlier periods of development, including: the historic background as a railway hub, cheap labour costs, good access to qualified labour, suppliers, and supportive institutions. Towards the end of the second development period however, access to foreign technology improved significantly in Zhuzhou as foreign firms started to discover the advantages of the city as a railway hub. For example, Siemens has been present in the city since 1998 through their joint venture: Zhuzhou Siemens Traction Equipment Co. Ltd.. The growing importance of lower tier cities in China helped Zhuzhou to move more into the focus of attention for Western firms and in turn, helped Zhuzhou's firms to gain access to Western technology.

“First tier cities are getting saturated as markets for many firms. The second tier ones are where the money is being made these days. They developed incredibly fast over the last ten to five years.”

(External Interview, 15)

Additionally, the rising manufacturing costs in the higher developed coastal areas caused work migration into the inland areas in order to capture cost advantages. This trend further benefited Zhuzhou and TMT, as its cost structure is lower than the one of its main domestic rival Sifang, which is based in Qingdao, Shandong province. However, Zhuhou's remote location also comes with disadvantages, as mentioned in the above section. TMT does struggle to attract foreign employees to work in Zhuzhou

as it is less attractive for foreigners than the coastal areas in China with a more Western social infrastructure.

TMT set up as a state-owned firm has treated it well, as their engaged managerial team overcame the associated shortfalls of this particular type of ownership model. TMT prospered in this protected and SOE favouring key industry, which presented an ideal set up for the technological ascent of the firm. Financial resources, access to markets, and institutional support were available in abundance TMT, whilst it was protected from external competition.

“TMT has very little domestic competition - we work mostly for CSR, whilst Sifang works for CNR. But there is some overlap and Sifang and TMT are even working together on certain joint-ventures. Sifang does not classify as a domestic competitor in a Western sense. We have, however, in recent years started to compete for the same business in the international market, which had caused minor resentments between CNR and CSR on occasion.”

(Interview, A.1)

In China, especially the aspect of access to financial resources plays a key role in the development of firms. As Chinese financial markets are state governed and are operating in strong favour of SOE firms, private owned firms are at a disadvantage for financial resources.

For TMT’s technological development, the abundance of financial resources proved to be essential. By the third period, any technology that TMT lacked in-house, but needed, was available in the market and given its abundance of financial resources, TMT was then able to buy it. TMT, moreover, always clearly stated that the acquired technology will be unbundled. The increased financial resources have not changed the ethos of TMT management towards technological innovation and learning, but it has eased access to technology for the firm.

“Whenever we come across technology we are missing or we are lacking the immediate capabilities to solve the issues by ourselves, we go and buy it externally. If

we cannot buy it, there is always the option of a joint-venture – trading market access for technology.”

(Interview, A.3)

“If technology comes from external sources - we do buy on occasion into technology if needed – we are always trying to understand the technology and improve it for our needs and develop it further where we can. [...] Money is not an issue – if it is needed, we buy it!”

(Interview, A.1)

The testing facility has also been funded through the parent company of TMT and it is suggested that TMT would have not been able to fund the facility on its own, but rather was dependent on CSR to support the decision financially.

“TMT management decided to buy the testing facility and its specifications. They did not pay for it – it was paid for by our parent company.”

(Interview, A.1)

The overall tenor in the interviews was that money is not an object or an issue for TMT. Financial resources were available for a wide variety of needs from technological development to business expansion. Several senior managers confirmed that TMT is trying to internationally expand and that M&A is the preferred vehicle to do so. The main motivation for the expansion is partly the intention to raise the firm’s profile, but also to access overseas markets through acquiring a foreign firm. An aspect of key importance especially in the railway industry, as many of the projects are state funded and many markets are highly regulated and protected. For example, the French market is hard to access for foreign firms due to French firms prefer domestic firms or firms with investments in France, while TMT is looking into the German market to raise its profile as a quality producer.

“Taking over a German firm had been a key goal for the management as they wanted to raise their profile and quality perception. They had been incredible eager to buy

Borge from ZF Sachs and ZF Sachs could tell. By my judgement, they overpaid on this deal, but money was not a deal breaker for TMT.⁷

(Interview, A.1)

The growth in size meant a higher visibility on a national level for TMT, as well as a move into the focus of central government attention. This is reflected in the firm taking part in the Chinese Innovation Torch Program, which is a central government initiative to foster the development of highly innovative firms in China. Yet, being comparatively small within the wider CSR organisation, TMT was allowed still to operate rather freely and unnoticed with very little impacts from political interventions or interests.

“Within the whole of CSR, we are rather small and operating in a niche. We are not in the focus of their attention. Targets are usually set by CSR and communicated to TMT, but this happens in a very commercial manner, as it would in any other firm too.”

(Interview, A.1)

“In every important meeting, there is a CSR representative present and sitting within the meeting room. However, normally he never intervenes or interferes in the meetings. He has a pure supervisory role, but usually is not really involved in the problems at hand.”

(Interview, A.5)

It is TMT's parent company CSR that has to face government interference and deal with it, as for example in the recent central government initiated merger between CNR and CSR. The merger has been forced by the central government based on the reasoning that two firms create too much internal competition. However, both Chinese and Western experts agree that the reason for creating the “巨无霸” (jùwúbà), which is Chinese and translates vaguely to the meaning of ‘Big Mac’, is the central government's ambition to build a leading international railway manufacturer (Erling, 2015). Being bigger in size also comes with its advantages, especially when

⁷ This perception had been confirmed by both an external consultant overseeing the project and one of TMT's managers participating in the M&A.

competing in the international market. TMT's grown size and established reputation with foreign buyers mean that TMT can more easily obtain new foreign contracts, such as, for example, the Toronto Metro. This was a project that TMT participated in and secured thanks to Bombardier bringing them forward as part of their supply chain (Bloomberg Technology, 2014). TMT is now being taken more seriously in the international market.

The overall industry development within the Chinese railway sector has been of great benefit for TMT as the domestic market is their key market. Due to the several infrastructure projects, their strong government support and the attention these projects have been subject to, the domestic demand in China has been considerable. One of TMT's senior managers summarised the situation in the Chinese market nicely when asked if the Chinese domestic market was their key market:

"The Chinese market is not our key market - it is THE key market for all of us – the current and expected growth rates are similar to none. China is the market and we are not done growing yet; there is still more to come for many years."

(Interview, A.9)

The Chinese railway industry is still strongly protected by the central government even though in recent years the levels of protection has fallen and selected foreign joint venture partners started to find ways in which to operate within the complex domestic market. These joint ventures are slowly starting to become competitors to TMT in the domestic market, but are still limited in their possibilities and in are in a less privileged position than TMT.

"In recent years, a few Western firms started to build production facilities in China and started to compete with us. They are causing us some competition in certain areas. They have better efficiency in place than we do and being located in China, they are close to the market too; allowing them to compete with us head on, which is a challenge as we do still compete on price mostly rather than quality."

(Interview, A.3)

Yet, the number of firms competing with TMT is still low. Usually the size of the market and the allure it has in getting foreign firms to sign into joint-ventures where technology is exchanged for market access exceeds those by far. For example, TMT's lead customer Bombardier entered into a joint-venture with CSR Sifang Rolling Stock Co. Ltd. - of which TMT owns a two per cent share - with the motivation to gain access to the domestic Chinese market (CSR Annual Report, 2013; Zhuzhou Times New Materials, 2013).

Further, the industry as a whole is strongly supported by the state, both financially and institutionally. The railway industry has been one of the biggest winners of the state intervention after the 2008 financial crisis. At the time the central government poured substantial amounts of money into infrastructure projects in an attempt to prevent the Chinese economy from slipping into a recession. Also, the current industry policies of the Chinese central government saw the railway industry on the winning side for institutional support (Renner & Gardner, 2010, McKinsey Report, 2015).

Period III Summary - Impact of firm characteristics and institutions onto firm's technology choice

The third period of TMT's technological development, which started in 2001 and is ongoing to this present day, is characterised by the firm's focus on innovation and development of indigenous technology. In comparison, during the second period of its path to technological ascent the firm's focus had been on learning through unbundling accessed foreign technology and on closing the gap between TMT and the West. TMT closed this gap in the year 2001, when it first started to apply for patent protection of their independently developed innovations. During the third stage of the firm's development, TMT's patent applications started to manifest and rise in number. Moreover, the patented innovations are being recognised in the wider industry by well-established competitors. This can be seen in the usage of TMT patents in forward citations. In this development period TMT successfully managed to overcome the biggest hurdle on the ideal path to technological ascent: moving on from imitation to innovation. It is worth to emphasise that TMT managed to overcome this challenge within 17 years of being established in 1984 as a self-funded firm and within seven years of securing GE as their first global lead key account customer.

National Institutions

The *national institutions* impacted TMTs' technological choice significantly, just as they did in the previous periods of development. In the first and second period, both the strong institutional support due to the firm's state-ownership, and the strong and growing protected domestic demand, impacted TMT's choices. In the third period, the aspect of external or foreign demand was added to the two former aspects. TMT's various collaborations with Western firms opened up overseas markets to the firm and created a reciprocal pull and push relationship between the firm and their customers. This special relationship fostered the firm's technological learning and unbundling of technology; enabling it to become an independent innovator, rather than merely an imitator of industry leading firms. The foundations for these foreign collaborations had been set towards the end of the second development period, but only generated wider results in the early stages of the third development period. The transition between the second and third period was of an evolutionary, rather than revolutionary character and as such cannot be exactly pin pointed towards one key event in the firm's history. The external collaborations boosted the intake of technology for TMT and enabled it to pursue an initial imitative strategy and subsequently allowed the firm to unbundle the obtained technology for an innovative strategy. At the same time domestic demand for higher quality technology products rose in line with the changed infrastructure needs; re-affirming TMT in its technological choice of an innovative strategy.

"The development and most of all the pace of the Chinese railway industry is very unique and different from any market conditions that can be found anywhere else in the world. The Chinese industry shifted immensely with the introduction of the high-speed railway program and so did the requirements put forward to the suppliers, which obviously impacted us and the way we operated in the domestic market."

(Interview, A.1)

"TMT was in a good position to meet the needs of the Chinese domestic high-speed railway as we had been a longstanding supplier for GE by that time and had already

been exposed to more advanced technologies – so it was not a complete shock to our system.”

(Interview, A.3)

Further, the state-ownership of TMT and the resultant financial and institutional security impacted the firm’s technology choice. It gave the firm the financial liberty to heavily invest into innovation and research. Not only did the parent company CSR support TMT financially, but being part of the wider CSR group also allowed TMT easy access to external capital through the state controlled Chinese banking system.

“Being part of CSR gives us the right connections to the right places – to make it short.”

(Interview, A.1)

“TMT has very good relations to both the local and regional government due to being a key employer and enterprise in the region. [...] I think China is not different than any other place in the world – having a good relationship matters and helps.”

(Interview, A.2)

As confirmed during several of the research interviews, TMT did at no point suffer any financial hardship. Moreover, being the technology expert in its niche, TMT was not subject to significant interference from the parent SOE in terms of their technological choices.

Firm Characteristics

In regards to *firm characteristics* that played a role in TMT’s technological choices during the third period of development, the new generation of management builds the starting point for discussion. The generational change in senior management changed the managerial skillset available to the firm. The historic focus on learning and research stayed in place, as the new generation of managers had grown within the firm and inherited these aspects of the company culture. But, being university educated they had also experienced a wider scope of Western managerial education. This is reflected in the firm’s organisational structure and its stronger focus for international markets. Additionally, a dedicated international business unit has been

created that focuses not only on sales to the respective global areas, but also analyses relevant markets for beneficial M&A partners to expand TMT's international presence.

“The industry is always in motion and as many others is looking for consolidation in many areas. TMT is considering its options very carefully to ensure the best possible outcome for us. M&A is a key tool for us to achieve our goals. [...] The cost of M&A is no concern for us as we are well positioned to cope.”

(Interview, A.6)

“We focus on any potential M&A that can allow us to grow and expand, but also to raise our profile. Having bought Borge in Germany helped us to get access to one of the leaders in lightweight materials – something that is somewhat off our core competencies – and further we accessed new international key accounts. Through Borge TMT is now supplying firms from Siemens to Porsche and that is an image gain for us.”

(Interview, A.1)

The above statements emphasise the continuous commitment of TMT's management to its chosen innovative technology strategy. Further, as already discussed in the earlier periods of technological development, TMT's staff had always been innovation focused learners. This has proven beneficial to the firm's technological development throughout the firm's history and continues to do so today. TMT has very little staff turnover in both the administration and manufacturing side of its organisation, which contributes to technological knowledge being retained in the company

“Most people joining TMT are doing so for a long period of time and as a result of this our staff turnaround is very small. We do not struggle to retain our talent in either manufacturing or admin, nor do we struggle to recruit any talent. We do however struggle to attract international talent and our turnover in foreign employees is higher than our average.”

(Interview, A.4)

Technology Strategy

The stability of TMT's workforce has a positive effect on its chosen technology strategy as it allows for technological knowledge to be retained within the firm and to build a corporate culture of learning. This had already been beneficial during the first periods of development, but has become of particular importance during the growth periods of the third step in its technological advancement. By having an established corporate culture that values learning and innovation, new entries into the firm will be briefed by more experienced TMT employees and values are being passed on. Further, the new managerial team has acknowledged the need for attracting and retaining its employees and revised the remuneration and incentives structure of the firm. The new system of remunerations and incentives has been developed in close collaboration with Western HR consultancies and takes into account aspects such as: individual performance, personal capabilities, and job responsibilities.

In summary, during the third and on-going period of technological development TMT has successfully moved on from imitation as a source of technology, to innovation. This fundamental shift in technology strategy took place in the early stages of the third development period. From this point onwards TMT's innovative technology strategy started to develop and is developing to this day. The new generation of management and the technological skill skills collected and build during the previous periods allowed TMT to successfully transition from an imitative to an innovative technology strategy.

5.3 Huawei Technologies Co. Ltd.

This section will analyse the case of Huawei Technologies Co. Ltd., an internationally renowned and technologically successful Chinese telecommunications firm. Whilst this second case differs from the first TMT case in terms of its ownership structure, industry and location, they are both technologically successful Chinese developing firms. Huawei is an unusual example. The firm is a successful privately owned domestic firm that is both operating in an industry of key strategic and economic importance to the Chinese state authorities, as well as being located in a coastal area that attracts considerable amounts of state attention. The academic literature, and in particular the elaborated work of Whitley (2007) suggests that the firm in this scenario would be faced with substantial disadvantages to achieving success in terms of technological innovation. However Huawei has managed to be both domestically and internationally successful, despite initial disadvantages in its access to external and internal resources over other domestic Chinese firms in a similar industrial and geographical setting. In this respect this case is similar to that of TMT. They have both managed to overcome substantial initial resourcing challenges and select the right technology strategy to suit their changing external and internal resources at each stage of their companies' development.

As such, this case examines the technological development of Huawei technologies and seeks to explore the linkages between national institutions, firm characteristics, and chosen technology strategy of the firm, across a several key periods on the firm's path to technological ascent.

5.3.1 Huawei Technologies – Background and History

Huawei Technologies Co. Ltd. (华为技术有限公司 - Huáwéi Jìshù Yōuxiàn Gōngsī), is a worldwide leading telecommunications equipment manufacturer headquartered in

Year	Key Event
1987	Huawei founded in Shenzhen as a sales agent for a Hong Kong based company producing PBX switches
1990	Starts to produce and commercialise on the obtained PBX technology targeting hotels and small enterprises
1992	Launch of Huawei's rural digital switching solutions as part of their commercial focus onto Chinese rural areas
1997	Expansion into China's big cities and coastal areas as Huawei launches its wireless GSM based solutions
2000	First R&D centre outside of China been established in Stockholm and international market sales, of mostly developing countries, reaches USD 100 million
2003	Huawei establishes its first major international JV with a key Western lead firm – Huawei & 3Com agree to jointly focus on enterprise data network solutions
2004	First breakthrough in Europe by securing the contract of a Dutch telecommunications provider JV with Siemens agreed to develop Synchronous Digital Hierarchy (SDH) solutions
2005	International contract orders exceed domestic sales for the first time in Huawei's history
2008	Recognised by the BusinessWeek as one of the world's most influential companies and ranked number three in terms of worldwide market share in mobile network equipment ⁸
2010	Joined the UN Broadband Commission for Digital Development

Shenzhen (深圳 - Shēnzhèn), within the Guangdong (广东 - Guǎngdōng) province.

The company develops, manufactures and sells a range of networking and telecommunications solutions. The company is organised around 3 core business areas: telecoms networks, business services (providing enterprise solutions and services to business customers) and devices. In terms of ownership, Huawei is a privately owned and managed enterprise and is listed on the Shanghai Stock Exchange. It is classified as an employee-owned Chinese enterprise as the firm's employees own the majority of its shares. The company employs over 150,000 people in more than 140 countries worldwide; of which almost half are employed in research and development. Today, the company supplies 45 of the top 50 telecommunication service providers worldwide, with a substantial amount of

the firm's revenue generated overseas. Huawei currently operates in 140 countries worldwide, supplying high profile customers such as: BT, Vodafone, Telecom Italia, Telefonica, France Telekom, Deutsche Telekom, O2, just to name a few (Huawei, 2015). As such, the company generated total sales revenue of 396 billion RMB (approx. GBP 46.3 billion) and net of profit of 36 billion RMB (approx. GBP 4.2 billion)

⁸ Based on statics of Informa as US based business intelligence agency focused on the technology and information sector. The BusinessWeek article can be found under:

in 2015 (Huawei, 2015). The company has certainly expanded significantly over the course of its 30-year history, an evolution that will now be discussed.

The company was founded in 1987 by Ren Zhengfei (任正非 - Rèn Zhèngfēi) in Shenzhen, Guangdong province as a small distributor of Private Branch Exchange Switch (PBX) products.

Then in 1990, Huawei moved away from being simply distributing equipment, and started to manufacture and to market its own switching systems instead. Struggling to compete with the established foreign owned firms in the more developed, coastal regions, they experienced disappointing sales results. So Huawei decided to target the niche of the less attractive rural market neglected by larger companies, by producing and selling lower-end switches and supporting services. This was strategically sound, as in the early stages of the Chinese Opening and Reform period most foreign owned firms focused their attention on the developed coastal regions leaving the rural areas largely untapped.

In 1993, Huawei achieved its first technological breakthrough with its C&C08 Central Office Switch, a digital switching solution especially targeted at rural areas in developing economies. Through personal political connections Ren Zhengfei managed to secure a municipal office in Yiwu, Zhejiang province, as one of Huawei's customers. Upon successful implementation of this switching system, Huawei was considered a legitimate potential supplier to other state-run offices (Harwit, 2008). This growing recognition amongst state-run offices provided Huawei with the profile to secure higher levels of state support, especially in terms of accessing capital for R&D projects.

By 1995 Huawei had generated RMB 1.5 billion (approx. GBP 175 million) in sales, mostly in rural areas. This success allowed them to make substantial investment in R&D, with a longer-term strategic focus shifting back towards the more developed metropolitan areas.

Huawei's domestic strategic approach of price competitiveness and value-added technology products, allowed them to gain a strong domestic foothold - challenging established companies in the industry. Inspired by its success the company started to target the international market in a similar way. By focusing on developing countries

such as Latin America and Africa first and establishing a strong reputation, before entering the more competitive and demanding established markets of Europe and North America. International sales figures for this period are impressive, with Huawei generating USD 100 million (approx. GBP 75 million) overseas in 2000. By 2002 the figure had increased to USD 552 million (approx. GBP 418 million), and finally in 2005 international sales outperformed the domestic ones for the first time in the firm's history (Huawei, 2013).

As discussed, Huawei is a privately owned enterprise operating in a Chinese 'pillar' industry and as such is a rarity. Huawei and its success challenge several common perceptions of successful Chinese companies. Telecommunications infrastructure is considered of crucial importance for a country's economic success, security and defence, hence often is under close state supervision in China. In the *Medium- and Long-Term Science and Technology Plan* released by the Chinese Ministry of Science and Technology, these industries are described as: "[...] *strategic pillar industries over which state-owned companies should retain absolute control.*" (Harwit, 2008). As a privately owned enterprise and not a state-owned or favoured company, Huawei faced an initially unfavourable position in terms of access to both funding and the state controlled ICT industry.

Therefore industry experts and academics have regarded the firms' successful rise from an unknown domestic Chinese player to a worldwide technological leader within the Information and Communications Technology (ICT) industry as surprising alike. However there are aspects to the to the ownership and governance structures that may go part way to explaining this anomaly.

5.3.2 Huawei Technologies – Ownership Structure

Huawei Technologies is a privately-owned enterprise, or in Chinese terms 'siyou siying qiye' (私有私营企业 – privately-owned company). However this definition challenges common Western understanding of 'private ownership' by actually being majority-owned by its employees. Huawei's Employee Stock Ownership Plan (ESOP) was introduced by founder Ren Zhengfei in 1990, and initially was used to compensate for the firm's disadvantage in access to external financial resources (Zhu & Hoffmire, 2013).

The ESOP, according to Ren Zhengfei, is built around the two Confucian values of equality and harmony, and it was Ren's intention to utilise it to both prevent significant wealth gaps between employees as well as to stimulate employee innovation and motivation (DeCremer & Tao, 2015). In this structure, employees are encouraged to act as entrepreneurs and take an active interest in bringing the firm forward through innovation as they are contributing to the wealth creation process. Its intention is to simultaneously serve both the firms' collective interests and the employees' individual interests by linking the actions of 'entrepreneurial' individuals to the success of the company as a whole and their own return (DeCremer & Tao, 2015).

The development and evolution of Huawei's ESOP structure needs to be understood in more detail to understand how this really differentiated this company. The ESOP was introduced in its first form in 1990, only three years after the founding of the company. Being a privately owned firm Huawei struggled to gain access to the state-led Chinese banking sector and hence was dependent on raising any needed capital internally. Hence, Huawei implemented an ESOP to circumvent the lacking access to external financial resources, seeking to generate the required funding by turning to its employees for financing without conceding any control to them. The details of the 1990 launched ESOP been described by Zhu and Hoffmire (2013; p.19):

"Huawei made available 15% of its stocks to employees, employees were not given the right to elect leaders or to manage and organize the company's ESOP program. The price of each share was 10 RMB. Huawei reserved the right to repurchase stocks at the price of 10 RMB per share from employees who left the company, and employee shareholders were not given bargaining power."

In light of substantial sales revenues in rural markets, by 1997 Huawei no longer required funding via employee shares. So they reworked their ESOP model to transfer the focus away from simply generating funds for the firm towards incentivising employee productivity and retention. In order to maximise the impact of the ESOP's incentive mechanism, the share prices were lowered from ten RMB to one RMB (Zhu & Hoffmire, 2013) and employees were strongly encouraged to participate in the ESOP. This made the scheme more accessible to all employees, and was also intended to bind qualified employees to the firm. In order to comply with changed Shenzhen Internal

Employee Stock Ownership (ESOP) regulations Huawei changed its ESOP into a virtual stock options based concept in 2001. The virtual share price was no longer fixed at a certain price but rather was based on the net assets of the firm; meaning that the share price can fluctuate rather than being set at a fixed price. Furthermore, the employee return was no longer paid as a fixed dividend, but rather was dependant on the profitability of the firm in the respective fiscal year and determined by the shareholder meeting. This particular change in the ESOP linked the net assets of Huawei and its employee's virtual stock value further, allowing for an even deeper alignment between the interests of the firm and its employees. However, it is important to emphasise that this change in the ESOP still did not confer any form of bargaining power or influence on the firm's management or strategic direction to the employees.

The overall set up of Huawei’s ESOP is rather complex, and even long-term employees of the firm seem to struggle to fully understand the details of the employee shareholding system (Zhao, 2010). Huawei’s internal set of company policies called “*Huawei Basic Law*” summarises the ESOP regulations as can be found in the below table 20.

Table 20: Huawei Basic Law – ESOP Regulations

Huawei Basic Law – ESOP Regulations

Paragraph 1	During April and May of each year, department heads determine the amount of shares, if any, each employee can purchase for that year. An employee’s position, work experience and performance evaluation results from the previous year may factor into the ESOP shares they are offered.
Paragraph 2	The company will set a maximum amount of stock that any one employee may be offered per year, and a maximum amount of stock any one employee may hold in total.
Paragraph 3	Employees must be eligible to purchase stock, and employees voluntarily choose to purchase or not to purchase employee stock.
Paragraph 4	The percentage increase in stock price is directly proportional to the percentage increase in net assets over the previous year.
Paragraph 5	The company decides upon the dividend amount at shareholders' meetings based on the profitability of the firm in the just-ended fiscal year. The company allows employees to apply for withdrawal and to sell their shares to the company. The company also has the right to withdraw stocks from poorly performing employees at a price based on the net asset values at the time of the withdrawal. Huawei’s employees have benefited from holding the shares of the company. We use a relative indicator—adjusted equity growth (owner’s equity per employee) to measure equity growth over the period from 2006 to 2010

Paragraph one and two address the way shares are allocated to employees based on their seniority and performance, as well as the overall maximum limitations on shares being offered to each employee. Paragraph three refers to eligibility of employees to purchase stock options, and currently this offer extends only to Huawei employees based in China. Paragraphs four and five detail remuneration on shares and dividends paid out to Huawei’s employees. Reading the above paragraphs demonstrates that the senior management within Huawei maintain an iron grip on key decisions regarding

the ESOP; and that although the firm is technically owned by its employees there is certainly no associated distribution of decision-making power.

Huawei's ownership structure has frequently been a topic of debate, due to the lack of transparency associated with the ESOP arrangement. The firm does not openly publish details of the ESOP setup, leaving room for speculation on the 'real' set up of shareholders behind Huawei. For example they have been openly criticised, most notably by the United States of America, who fear that the opaque ownership structure is masking Chinese state involvement (Ahrens, 2013). In response, Huawei's CFO Meng Wanzhou announced during a press conference in 2012 that the details of the ESOP will be made public, and the annual results of the firm presented - a promise which has yet to be delivered (Mozur, 2012). Weng commented at a later press conference on the ESOP but did not offer a timetable for the release of information, instead invoking employee privacy as an explanation for the delay:

"We want to release the ESOP list. But our company is an employee-held company. There are 70,000 employees' holding company shares. So that is a matter of employee's privacy."

In summary, the unique ownership structure of Huawei provides a partial explanation for why it has flourished in spite of an initially disadvantageous position. The ability to raise funds internally, as well as motivate and retain more entrepreneurial workers goes some way to explain why they have been successful where other privately owned firms have not.

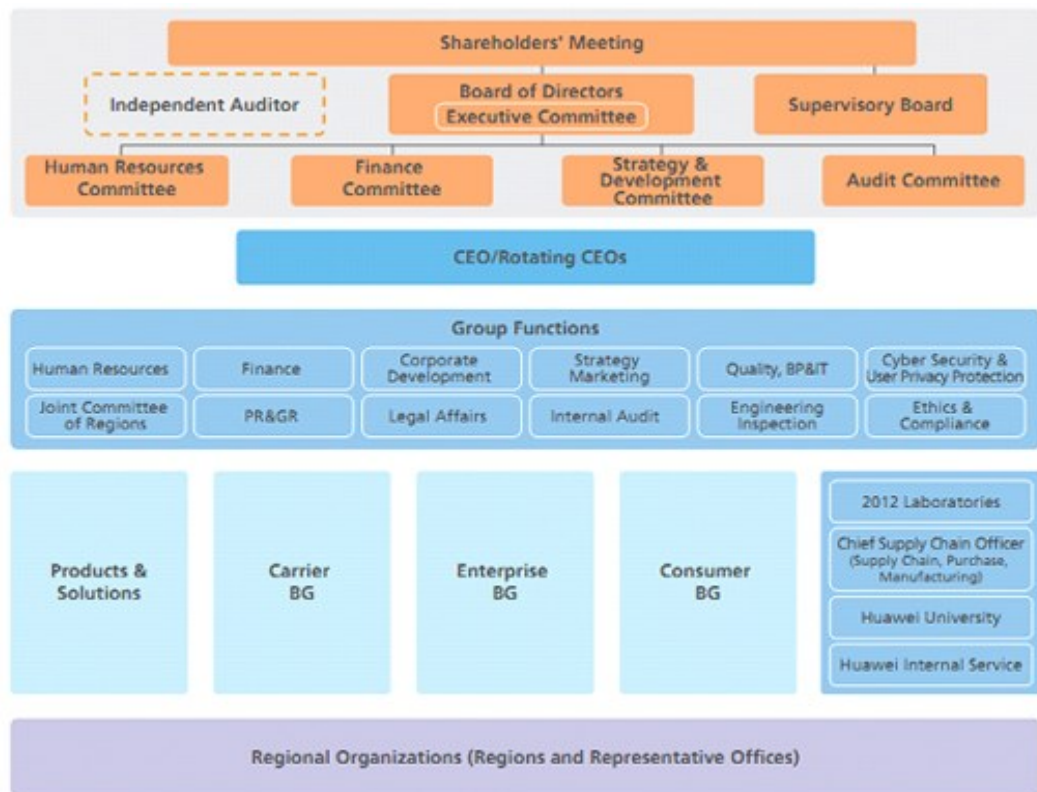
However its concept of 'employee ownership' is very different to models of employee ownership seen in Western countries. To understand Huawei, it is important to disconnect the concepts of ownership and control. Huawei's ESOP was born as a tool to internally generate funds and at a later stage utilised as a motivational tool for the firm's employees. At no point was it Ren Zhengfei's intention to delegate managerial decision power away from management, or allow for employee bargaining power to emerge. This is clearly demonstrated in the regulations of the ESOP, as stated in the Huawei Basic Law.

The following section will now analyse how the governance structure operates in the context of this ownership model, and further examine the impact of this disconnect between Huawei ownership and managerial decision power.

5.3.3 Huawei Technologies – Governance Structure

Huawei's current governance follows a hierarchical structure based on common shareholding firm structures with several unique characteristics. Founded as a privately owned firm, it is perhaps unsurprising that a considerable degree of autonomy still lies with the CEO Ren Zhengfei. The different group functions of the firm are being steered by the firm's CEO who is further supported by a set of rotating CEO's (Figure 10). Above the managerial levels of the CEO are a series of Committees, which are supervised by the board of directors. The CEO and rotating CEOs report to the board of directors, who in turn report the shareholders at the shareholders meeting (Huawei, 2015). A further interesting aspect of this governance structure is that the independent auditor is indicated as a fixed feature within Huawei's organisational chart. The permanency of this audit committee may reflect a response to criticism from cooperation partners and customers of Huawei's lack of transparency, notably in terms of opaque auditing and accounting practices. As a private non stock market listed firm, Huawei was not required to publish any public accounts. Even now the privately owned firm is not forthcoming with quarterly figures, and only publishes annual reports that reveal a selected range of figures, which tend to cast the company in a positive light. So even once published, the quality and consistency of the financial information was questionable and as a response the independent auditor was introduced as a separate external function to provide legitimacy to the information. The firm's group functions (HR, Finance, Legal) are centralised and cover all four of the business divisions, which in turn are based on the four core business areas of Huawei (Products and Solutions, Carrier, Enterprise and Consumer). Diagram...provides an overview of this governance structure.

Figure 10: Huawei - Organisational structure



(Huawei, 2015)

Ren Zhengfei is the figurehead of Huawei and is often referred to as the founder and owner of Huawei, which is only partly correct. Whilst he did found Huawei in 1987, according to the firm he only holds a 1.4 per cent share of the firm, with the remaining shares being owned by the firm's employees. Despite minimal shareholding, he still leads the firm in its strategic decisions as CEO. Meanwhile the management team around Ren has expanded consistently over the years and now comprises seventeen people; of which twelve head the respective group functions, one functions as CFO, and three support Ren as rotating CEOs (Huawei, 2015).

Figure 11: Overview - Huawei CEO Rotation

Rotating CEOs

Huawei implements the rotating CEO system under the BOD's leadership. As the primary owner of the company's operations and crisis management during the tenure, the Rotating and Acting CEO is responsible for the company's survival and development.

The Rotating and Acting CEO convenes and chairs the company's EMT meetings. During routine management decision making, the Rotating and Acting CEO promptly notifies BOD and Supervisory Board members of responsibility fulfillment.

Three Deputy Chairmen take turns to act as the Rotating and Acting CEO for a tenure of six months. In 2015, the acting tenures for the three rotating CEOs are as follows:

- Mr. Hu Houkun: October 1, 2014 – March 31, 2015
- Mr. Xu Zhijun: April 1, 2015 – September 30, 2015
- Mr. Guo Ping: October 1, 2015 – March 31, 2016

In the 2011 Annual Report Huawei announced the implementation of a unique rotating CEO system, whereby the three Deputy Chairmen of the Board –Guo Ping, Xu Zhijun, and Ju Houkun – serve for six months terms as Deputy CEO alongside of Ren Zhengfei on a rotating basis (Huawei, 2011). All three members of the rota are longstanding members of Huawei and joined the firm at very early stages of its development. This means that they all possess a deep understanding of both the firm's technology and their organizational structure⁹. It needs to be pointed out however that in all the official Huawei

communications these three rotating CEO's are referred to specifically as "Rotating CEO's" thus differentiating them from the ultimate "CEO" of Ren Zhengfei. This difference, although small, is particularly important in a country such as China, and provides a clear indication that Ren Zhengfei maintains an elevated position in the governance structure, and influence over decision-making processes.

Huawei did not provide any elaborate justification for the unusual choice in managerial leadership structure but – given Ren Zhengfei's (71 years) age – it could be seen as a proactive and strategic managerial approach to succession planning. This is of particular importance as the firm's success has been so closely connected to the Ren Zhengfei's individual leadership style as a CEO in most of the academic discourse on the company.

From a Western perspective, Huawei's management team is also unusual in its average length of tenure for a privately owned enterprise of its size. All of the key managerial

⁹ The members of the CEO rotation system all joined Huawei from a very early stage onwards: Guo Ping joined 1988, Xu Zhijun in 1993, and Ju Houkun in 1990 according to Huawei's public communications. Further their tenure is communicated publicly and currently stands as follows: Mr. Hu Houkun: October 1, 2014 – March 31, 2015; Mr. Xu Zhijun: April 1, 2015 – September 30, 2015; Mr. Guo Ping: October 1, 2015 – March 31, 2016 (Huawei, 2015).

personnel have been in their respective positions for a considerable amount of time and generally have been employed at the firm for at least 20 years. Most of the leading managers of the firm joined Huawei during its first or second period of technological development (between....) and have stayed with the firm ever since (Huawei, 2015). Sun Yafang, the Chairwomen of the Board has been with Huawei since 1989 and comes from an engineering background. She graduated Chengdu University of Electronic Science and Technology in 1992 with a bachelor's degree in engineering. Prior to her start with Huawei she worked as a technician at the state-owned Xinxiang Liaoyuan Radio Factory until 1982 and joined the Beijing Research Institute of Information Technology as an engineer in 1985. She holds the position of Chairwomen of the Board for seventeen years now and it took her ten years from joining the firm to become its leading women. Looking at the biographies of Huawei's wider management team and the team of rotating Deputy CEOs in particular, this pattern continuous with all of them having joined the firm at a very early stage in its development and all members are degree educated to bachelor or master level. Most of the senior members of the managerial team joined Huawei at a very early stage of their career if not even right after their graduation. This is perhaps unsurprising for a firm that has actively sought to 'bind' employees to it via the ESOP mechanism, but it has some substantial advantages. As long serving employees, senior management are well connected to the firm and its historic development, making them very aware and knowledgeable of the firms' changing technological needs and overall industry development. As such they are better placed as managers to make informed and evidenced decisions regarding Huawei's technology strategy. Moreover, the senior managerial team's involvement is further reinforced through Huawei's unique ownership proposal.

5.3.4 Huawei Technologies – Performance Indicators

Huawei's financial development in recent years certainly seems to have been impressive. However due to the limited availability of verifiable financial information it is difficult to assess their performance objectively. Certainly the financial results published in the 2015 Annual Report were noteworthy, reflecting a 35 per cent increase in sales revenues. Table 21 provides an overview of the development of the firm's financial results from 2010 to 2015.

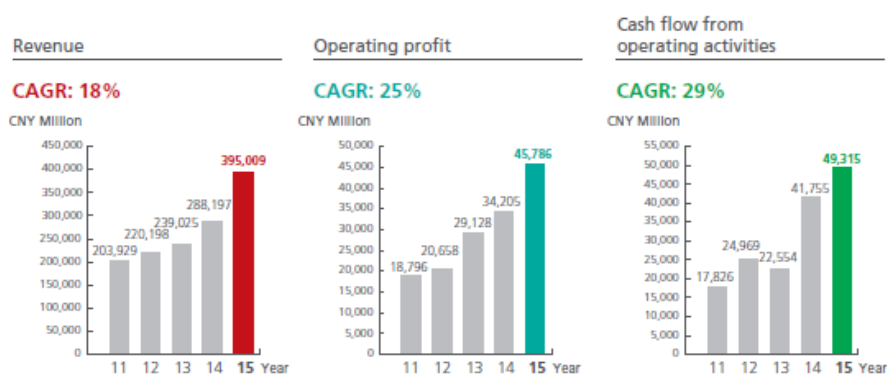
Table 21: Huawei - Financial Results by year

	2015		2014	2013	2012	2011
	(USD Million)*	CNY Million				
Revenue	60,839	395,009	288,197	239,025	220,198	203,929
Operating profit	7,052	45,786	34,205	29,128	20,658	18,796
Operating margin	11.6%	11.6%	11.9%	12.2%	9.4%	9.2%
Net profit	5,685	36,910	27,866	21,003	15,624	11,655
Cash flow from operating activities	7,595	49,315	41,755	22,554	24,969	17,826
Cash and short-term investments	19,284	125,208	106,036	81,944	71,649	62,342
Working capital	13,711	89,019	78,566	75,180	63,837	56,996
Total assets	57,319	372,155	309,773	244,091	223,348	193,849
Total borrowings	4,464	28,986	28,108	23,033	20,754	20,327
Owner's equity	18,339	119,069	99,985	86,266	75,024	66,228
Liability ratio	68.0%	68.0%	67.7%	64.7%	66.4%	65.8%

*Note: Translated into United States dollar ("USD") using the closing rate as at December 31, 2015 of USD1.00 = CNY6.4927.

The financial results most notably highlight the five-year development of operating profit and operating margin, with profits almost doubling in the period and profit margin being up by 2.4 per cent.

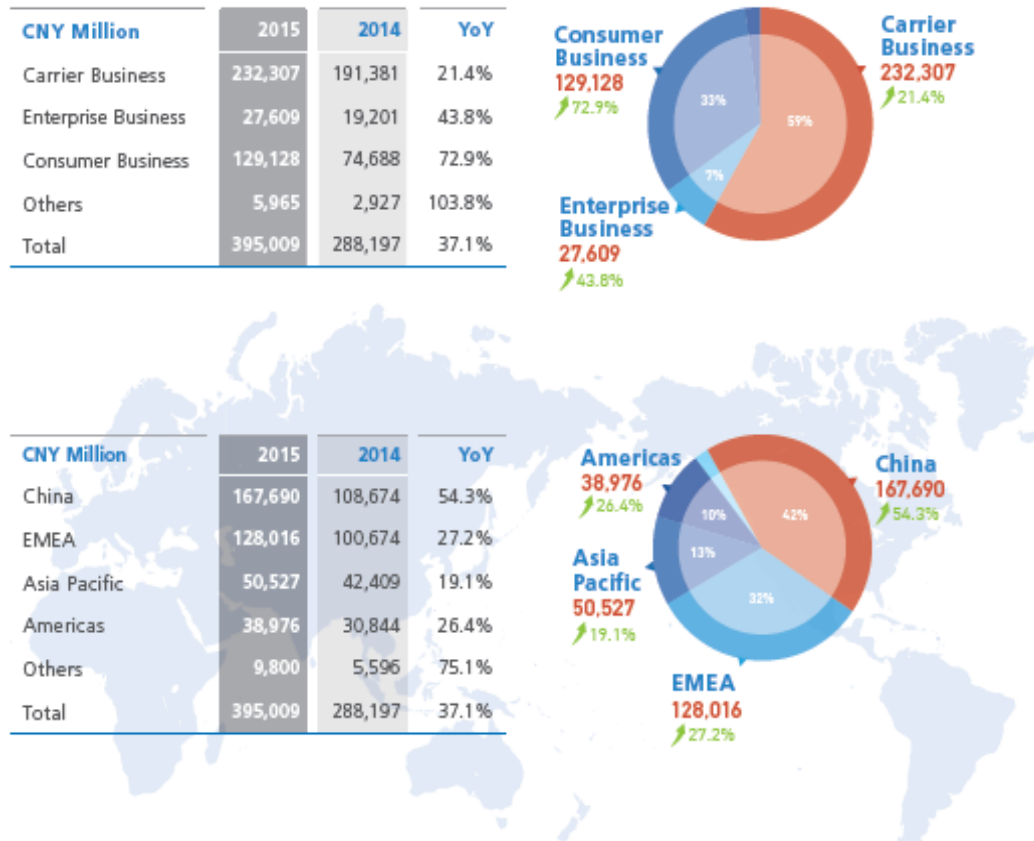
Table 22: Huawei - Performance Indicators



Year on year the revenue grew by 18 per cent and the operating profit by 25 per cent as can be seen in the above graphic. This high growth in domestic demand, with revenues being up by 54.3 per cent year on year, was primarily driven by heavy

investment into 4G telecommunications equipment by the Chinese state (Reuters, 2014). The network rollouts also strengthened the importance of the carrier business unit (Huawei, 2015): as can be seen in figure 10 which provides a detailed overview of Huawei’s main business areas and sales markets.

Figure 12: Huawei - Overview main business areas and sales markets

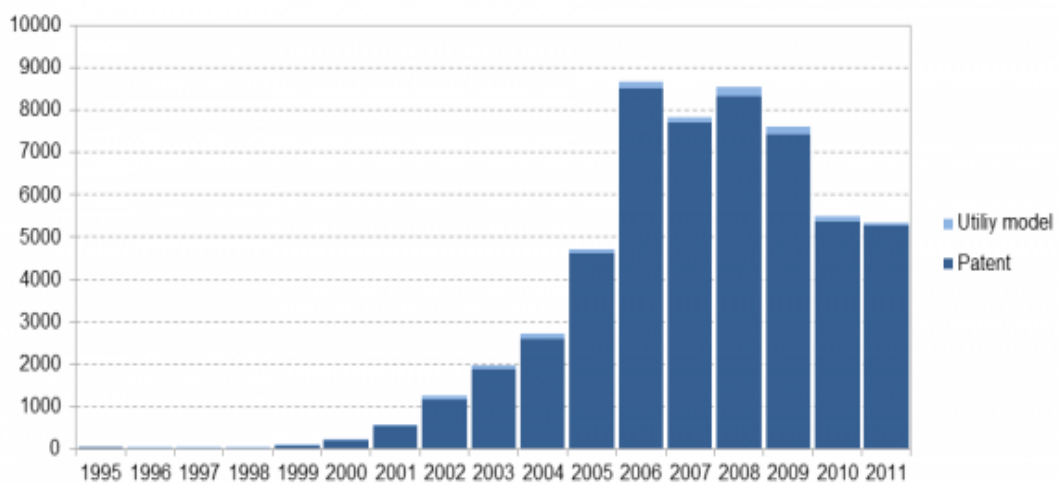


After China, Europe is the firm’s second important market. Comprising 32 per cent of the firms overall sales, the importance of Europe derives from an increasing share in wireless networks and a strengthened presence in the smartphone sector. However Huawei is still strong in developing markets and is also benefitting from the infrastructure pushes in countries such as India, Philippines, and Thailand.

Patent applications are commonly used in the literature to judge the levels of technological advancement a firm has achieved over the years of its development. Huawei has always been determined to offer innovative products through high levels of research and development and is member to 300 standards organisations, industry alliances, and open source communities (Huawei, 2015). Initially focused on being a low-cost, low-tech provider to rural markets, it is perhaps unsurprising that Huawei’s

first significant number of application for patents took place in 1999 – twelve years after its inception. However since then they filed a high number of patents consistently until 2005. From 2005 onwards the number of applications became more erratic due to the wider waves of innovation across the telecommunications sector, and changes between different generations of technology standards. Moreover China’s WTO entry in 2001 was noteworthy for changing the general attitude of Chinese firms for patent applications. Upon entry China committed to implementing the ‘Trade-related Aspects of Intellectual Property Rights Agreement’ in full and therefore maintaining intellectual property rights became more important for Chinese firms. More and more firms starting to file for patent protection of their inventions at this time. For Huawei, this event coincided with the firm maturing its path for technological development. So as early as 1999 Huawei had started to apply for patents albeit few in number (Table 23).

Table 23: Huawei Technologies Co. Ltd. – Patent & Utility Model Applications by year



Source: „China Innovation“ – Comparing Worldwide Patent Portfolios, www.china-innovation.de, Study of the Munich Innovation Group and TU München, calculated with EPO Worldwide Patent Statistical Database (PATSTAT), Licensed by OECD/EPO Taskforce on Patent Statistics.

The number of patent applications increased rapidly from 2001 until 2006, with 2006 being a key jump for the firm’s technological knowledge base as patent applications almost double year on year. This fast development can be explained with Huawei’s increased investment into R&D with the firm early on investing around ten per cent of their sales revenue into their technological development (Harwit, 2008; Huawei, 2011). It is notable that Huawei tends to apply for full patents, and that utility models only play a rather inferior role for the firm in their technological progression. This is unusual for a developing firm as utility models are usually easier and cheaper to obtain at the

expense of shorter protection validity. However, Huawei is investing into full patent applications and therefore benefitting from the full 20-year patent protection. This implies a longer-term view to taking technological advantage over their competitors.

Furthermore Huawei has not only been applying for patents in China but also in other countries worldwide. This clearly shows that Huawei’s innovative work is focused on development beyond the domestic market in China, perhaps reflective of a more international orientation of the firm. This regional divide is illustrated in table 24 which provides an overview of patent application by country.

Table 24: Huawei Technologies Co. Ltd. – Patent applications by region



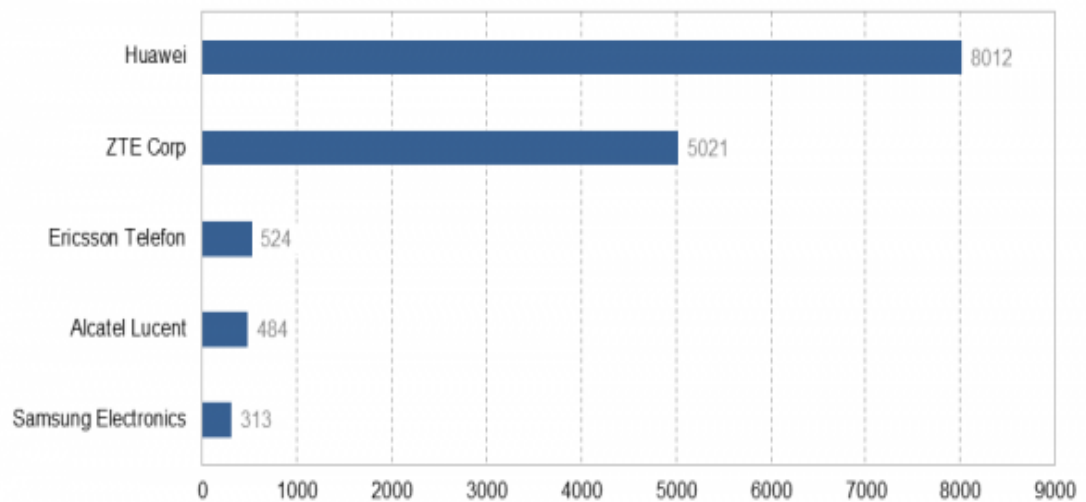
Source: „China Innovation“ – Comparing Worldwide Patent Portfolios, www.china-innovation.de, Study of the Munich Innovation Group and TU München, calculated with EPO Worldwide Patent Statistical Database (PATSTAT), Licensed by OECD/EPO Taskforce on Patent Statistics.

During the period of 2003 to 2005 most of the firms patent applications had been filed in China, as the firm’s most important market. However the phase from 2006 to 2008 demonstrated a clear shift away from China with almost one third of the firm’s patent applications being filed outside of China. This shift in patent application by region is not only explained by the shift in sales focus, but is also reflective of a development of international research activities. In 2015, Huawei operated 16 R&D centres worldwide and was actively involved in 36 joint innovation centres, expanding the firm’s research presence to around 150 different countries worldwide (Huawei, 2015).

Forward citations can be used as an indication of the worth of a patent as it shows how often a patent has been cited in other patent applications. The more often a patent is

cited by other firms the higher its impact within the industry is and the more technological value can be associated with it. By looking at diagram... showing the number of forward citations for its patents and utility models, it becomes clear that Huawei's innovations have significant impact externally. They had 34,000 forward citations for its patents and utility models in 2014. Amongst the firms using Huawei patents are well-known global players like its domestic competitor ZTE, Ericsson, and Samsung. Meanwhile in-house citations further indicate that Huawei is extending the application of the respective patent and expanding on its applicability.

Table 25: Huawei Technologies Co. Ltd. – Technologically related companies



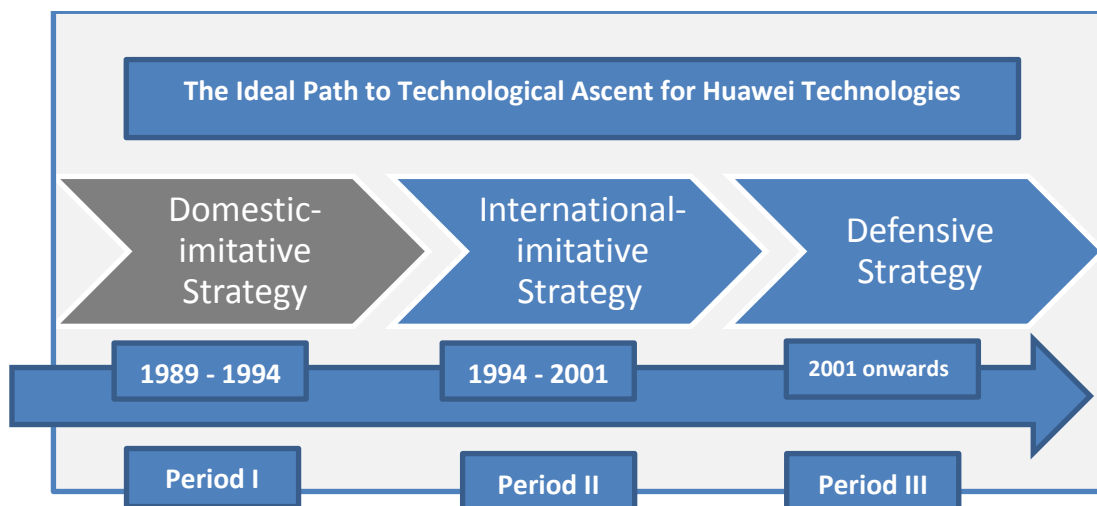
Source: „China Innovation“ – Comparing Worldwide Patent Portfolios, www.china-innovation.de, Study of the Munich Innovation Group and TU München, calculated with EPO Worldwide Patent Statistical Database (PATSTAT), Licensed by OECD/EPO Taskforce on Patent Statistics.

Huawei has recorded a very positive performance over the past years with sales, revenue, and gross profit figures all continuously increasing year on year. The profit margin is continuously increasing and performance is reaching the levels expected of industry leaders such as Ericsson or Cisco. The operating profit is undoubtedly the most notable indicator, with the figure almost doubling from 2011 to 2015. In terms of Huawei's patent applications, the firm is also demonstrating generally consistent growth albeit in a more cyclical pattern affected by, and representative of, wider industry developments. Certainly the focus on the domestic market is reducing with Huawei moving away from solely national patent applications to international ones due to the firms' increased international research activities.

5.3.5 Huawei Technologies – Development Period I from 1987 onwards

Looking at the background context, ownership and governance structures and performance indicators it is clear that the technological development of Huawei Technologies can be divided into broad stages. Huawei's ascent has been characterised by soft transitions between the different stages in technology strategy. These specific stages will now be examined in more detail.

The first period of technological development started with the firm's founding in Shenzhen in 1987 during which Huawei started to develop its first set of technological capabilities. Five years later, in 1992, Huawei moved away from domestic sources of technology and utilised foreign technology to further expand its initial set of technological capabilities. Then Huawei managed the final leap from an imitative technology strategy to a defensive one in 2001 with the firm's first set of international patent applications.



As discussed previously Huawei started its path to technological ascent as a distributor of a Hong Kong based firm, simply selling and distributing their switch technology. Then in 1990, Huawei took the lead from distributor to manufacturer and started to develop, manufacture and sell its own products. Starting as a distributing firm with no prior manufacturing experience, Huawei possessed low levels of technological capabilities at the early stage of development. Ren Zhengfei as owner of the firm brought his personal knowledge and technical capabilities into the firm, but beyond his engineering background Huawei had only limited capabilities to start its technological ascent from. This resulted in the firm choosing a domestic-imitative technology

strategy during its first period of development. The choice was not only rooted in the limited technological capabilities, but also because Huawei at this point in development was too small and insignificant to access foreign technology for either a dependent or international-imitative strategy, leaving Huawei with the domestic-imitative technology strategy as its only viable choice in this particular stage of their path to technological ascent.

Firm characteristics

With limited technological capabilities, during the first development period the firm's internal resources were mostly focused around the abilities of the owner and founder of the firm, Ren Zhengfei. As such Huawei's management was, and still is, strongly influenced and characterised by the authoritarian leadership style of its owner. He graduated with a degree in civil engineering and architecture from Chongqing University in 1960. After his university degree he worked as an engineer for the military and developed his technological skills further. It is often pointed out in literature, that Ren's unique leadership style is influenced and rooted in its military working experience (Harwit, 1997). Ren Zengfei was keen from the beginning to engage his employees through shared targets and closely integrate them into the firm's development.

“Vision and targets are important for the success of a firm – Huawei is very good at having a shared vision and target – it always has been from its very beginning.”

(Interview, B.3)

During the first period of Huawei's technological development Ren Zhengfei was the driving force in developing the firm from a mere distributor of switches to an independent manufacturer. As a privately owned enterprise, of a small size and in a volatile market environment the firm operated with a small and hierarchical management structure. This allowed for the influence of the leading manager to intensify. Huawei was able to benefit from an engaged and committed CEO, and his willingness to invest into a long-term strategy for the firm allowed for this strategic transition from distribution to manufacture.

During its early stages of development, Huawei's need for specialised and trained *labour* was rather limited. Even upon starting to manufacture, its labour needs were mainly for cheap manufacturing workers. This type of worker was readily available through the continuous migration of rural workers moving to the more affluent coastal areas.

Furthermore, due to its location in an Information and Communications Technology (ICT) hub skilled workers could be poached from more established ICT firms when required allowing Huawei to access their knowledge and skill sets with relative ease:

“Guangdong has always been a hub for light-industry manufacturing from very early days onwards due to its close location to Hong Kong and Taiwan. Many of these firms used the area as a manufacturing base for their products due to the low cost structure and good availability of qualified workers.”

(External Interview, 11)

At this point it is also worth mentioning that due to the limited technological complexity of the initial switches produced by Huawei there was only a limited need for the firm to recruit highly skilled engineers. Ren Zhengfei's own technological capabilities are believed to have been sufficient to cope with the challenges to unbundle and integrate the needed technology. However they could be recruited in a similar manner, if necessary as they could be easily accessed and poached from other suppliers or JV firms based nearby. This practice allowed Huawei to benefit from spill over effects in the area and recruit the needed personnel cheaply and easily.

The firm started in 1987 with RMB USD 20,000 in registered capital and a fixed number of employees of around 20 people, a very small firm. As such it is not surprising that the firm's *organisational capabilities* during the first years of development were focused on responsiveness rather than quality or technological supremacy. The levels of technological capabilities that Huawei started out were rather low and left the firm with a limited choice in terms of their technology strategy. Most of the firm's initial technological capabilities rested on the personal skill set of the firm's owner. His expertise was derived from his extensive engineering background. Ren Zhengfei worked as an engineer for the People's Liberation Army (PLA) in one of their

information technology research institutes as a military technologist¹⁰. Between 1983 and 1987, after his time with the PLA, he worked in Shenzhen in the Electronics industry allowing him to build a good relationship network amongst firms and suppliers in the industry. This personal network of relationships is assumed to have helped Ren to overcome the initial prohibitive hurdles of entering the ICT industry to establish Huawei. It took Huawei about three years to manage the technological jump from distributor to manufacturer which is mostly rooted in the need for building up the firms technological capabilities from the ground up.

National Institutions

The external factors influencing Huawei's progression on the ideal path of technological ascent are location, ownership, size, and industry. These four aspects influence the external resources available for Huawei to access and utilise in their technological development. They also further impact the firm's interaction with the domestic institutional environment due to their different set up configurations.

During Huawei's first period of development the firm's coastal location proved to be advantageous to the technological advancement as it placed Huawei at the forefront of China's Opening and Reform Policy. The coastal areas had been leading the way in technological development with Western firms accessing the Chinese markets in various industries first in the large more developed coastal cities. For Huawei this meant it had good access to foreign technology, foreign labour, and foreign supplier networks but also could benefit from spill over effects of these into the wider local ICT industry, as discussed already. As early as 1989, Huawei managed to gain access to foreign technology via the Shanghai-Bell JV as third party supplier allowing the firm to expand its technological capabilities by unbundling the accessed knowledge¹¹.

¹⁰ Ren Zhengfei, albeit his military background is often cited as the source for his leadership style, never held any military rank during his time with the PLA. He was banned from joining the PLA and Communist Party due to his family's affiliations to the Kuomintang regime in the 1940s (Harwit, 2008).

¹¹ Huawei worked as a switch supplier for the Sino-American joint venture of Shanghai-Bell. This connection between Huawei and the foreign JV is often cited as the origin of Huawei's first technological capabilities. In its early stages of development Huawei closely worked with the Centre for Information Technology (CIT). It is assumed that technology diffusion amongst the cooperation partners allowed the jump from a mere switch distributor to becoming a producer.

“Shanghai-Bell was Huawei’s first foreign joint-venture and a stepping stone in the firm’s history. It is of great importance for the firm and marks a historic moment.”

(Interview, B.2)

Certainly Huawei benefitted from the new infrastructure created in the coastal location, associated with the establishment of foreign JV firms. In the early days of China’s economic development, very few international JV been set up in more rural areas and even within the same province there could be wide differences between coastal and inland locations. The impact of these benefits is clear in the example of Guangzhou-Peugeot. Founded in 1985 the firm was based 150 kilometres further inland from Shenzhen in the rural inland, and was one of the first automotive JVs in China. More notably it was also one of the few cases that failed, with many commentators suggesting the location as a key contributor to its lack of success.¹² Shenzhen further benefited from its close proximity to Hong Kong and its special status during the opening and reform period of China as a Special Economic Zone (SEZ): Shenzhen was designated as a Special Economic Zone 1980, so the Shenzhen local government maintained strong influence over local industries and state entities sought to execute close supervision over these. The ICT industry is considered an industry of strategic interest to the Chinese government and as such is even closer monitored by state entities. However this location also ensured access to strong supplier networks, foreign technology and skilled labour:

“Huawei’s Shenzhen location close to supplier networks and competing firms was and is of great advantage to the firm. Shenzhen is one of the leading cities in the Chinese ICT industry and is referred to as the Silicon Valley of China.”

(Interview, B.3)

¹² Guangzhou-Peugeot was founded in 1985 around the same time Shanghai-Volkswagen was founded. The JV was set up between the French PSA Group and the municipal government of Guangzhou. The intention was to build up a local supplier network through localisation targets in the JV agreement, which never materialised or only to a very limited degree. This was mostly rooted in the firm’s struggles to build a suitable local supply chain up and the local parts produced caused the overall product quality of the cars to deteriorate and make unattractive against the few competitors present (Fernandez & Liu, 2007). Albeit following a similar model to SAWC-Volkswagen, by introducing outdated Western models in China, the JV never managed to gain traction and become successful (Thun, 2008). In 1993, Guangzhou-Peugeot sold only 2.500 cars while Shanghai-Volkswagen sold 146.000 during the same time period (Fernandez & Liu, 2007). In March 1997 the joint-venture was ended in a mutual agreement between PSA and Guangzhou municipal government.

In this way Huawei's coastal location was obviously advantageous, however there were disadvantages for to the firm's own technological development.

In this context state owned firms were consistently preferred to privately owned enterprises as they were easier to monitor and control. As a privately owned firm in this location it was considerably harder to gain traction in the market.

The ICT industry in China is considered to be a strategic pillar industry and as such usually is not widely accessible for private firms as it is dominated by state controlled firms.

"Market entry for private firms was especially difficult to obtain in any important key sector, such as telecommunications, as they usually been tried to keep under close state control and therefore are kept in the hands of SOE firms."

(External Interview, 13)

They lacked the preferential treatment offered to SOE's that provided access to strategic domestic innovations and financial support. Although Huawei was able to circumvent the restrictions placed on POEs in this pillar industry primarily through the simplicity of the technology it utilised and the rapidity of domestic growth, combined with its small size and initial insignificance in the industry.

The relative simplicity of the technology involved in switching systems conferred advantages to this new entrant. The initial technological threshold for newcomer firms as switch manufacturers was low in comparison to other industries in the technology sector. This allowed Huawei to easily reverse engineer some of the simpler components created by foreign competitors, irrespective of its initial low set of technological capabilities. Furthermore by focusing more on responsiveness than technological excellence and operating in a market niche that was deemed of little importance to the local and central government, they attracted little attention and interference from state authorities.

Huawei also benefited greatly from the large growth in demand from the domestic Chinese ICT market isolated from foreign competition. This provided them with an isolated market in which to hone their technological offering without the pressure of

substantial foreign competition. For example in the early 1990s, they turned to the less developed Chinese rural areas, which offered a large untapped domestic market. This market was mostly closed to foreign competition due to their lack of market understanding; particularly in terms of, market demand criteria, language barrier, product suitability, and local government specifics. Many of the foreign firms that had previously tried to access this market had offered products that were either unnecessarily high-tech, or lacked robustness to meet to specific needs of the rural market demands and failed as a result.

Despite its disadvantages, operating in a pillar industry did offer certain protections as well. Access to the ICT industry was strictly controlled by the central government, especially for foreign owned and operated firms. As such the degree of competition faced by Huawei was limited, with more advanced foreign competitors particularly restricted. The large Chinese domestic market therefore acted as an incubation space for domestic firms, allowing them to grow their technological capabilities in a more protected space.

Their small size also proved an advantage for Huawei initially. As a firm it was simply too small to concern the authorities. Its diminutive size did not represent any risk or real competition to any of the state owned firms, meaning it could enter the key ICT industry with little to no state interference. Or as a Chinese academic who is very familiar with Huawei's history phrased it:

"I think for the first five years, Huawei was so small nobody noticed what they had been doing nor did anybody care. They did not step on anybody's toes by taking away their business or interfering with their attempt to get foreign technology via a joint venture. That only changed once people started noticing how much money Huawei made in the rural areas and the pace of the firm's growth but by that time Huawei was already a force that could hardly be stopped."

(External Interview, 13)

However, being so small also had several disadvantages. Not only was Huawei too small to be noticed, but it was also too small to matter as a strategic player in the ICT industry. Its insignificant role in the industry meant it struggled to secure access to

qualified personnel or external financial resources. Furthermore, the small size and associated lack of importance or industry impact meant that it was unable to rally any favourable state support or advocacy for its development. Although their industry influence and technological capabilities improved as Huawei grew and developed, during the early stages of technological development its primary capabilities originated primarily from the owner and founder Ren Zhengfei.

However as a POE access to external capital through the state controlled banking system during this time was very limited and therefore increased financial constraints on the firm, as illustrated by...:

“Financial access for POEs was virtually impossible during the early days of China’s economic boom and even up to the late 2000s it was far from good. The focus of the banking sector was resting on the state-owned firms and joint-ventures while private firms played no real role, especially the small and medium sized ones.”

(External Interview, 13)

Although restricted in access to state funding, as a POE Huawei did benefit from engaged managerial owners with a solid technical understanding of the industry and comprehension of the importance of investing in technological development and learning:

“Ren Zhengfei is a great leader for Huawei and the firm would not be where it is today, if would not have been for his continuous efforts and determination. He has always been committed to technological development and leading the firm to success.”

(Interview, B.2).

Size is a further external influence for Huawei’s initial period of technological development. Huawei started as a very small firm with only very limited financial and labour resources focusing more on responsiveness than technological excellence. As previously mentioned, the firm was during its first phase of development faced with a multitude of challenges and threats to its existence, such as: low levels of funding, limited market access, and little technological capabilities.

Period I Summary - Impact of firm characteristics and institutions onto firm's technology choice

Firm Characteristics

Both the external and internal resources affect the firm's choice in technology strategy for a variety of reasons. In the case of Huawei, the *internal resources* during the first period of technological development stayed mostly consistent with the exception of the firm's technological capabilities. As discussed, the firm managed to successfully overcome their lack of technological capabilities and move away from being a distributor to become a manufacturer of switches.

Certainly it can be stated the key influence in terms of internal resources on Huawei's technology strategy was its initially limited technological capabilities. As examined, their primary capabilities originated from Ren Zhengfei's personal skill set, which in turn was rooted in his engineering background.

"He (Ren Zhengfei) is an engineer and had many years of experience in the ICT industry when he founded Huawei. It was greatly to his knowledge and experience that helped to develop Huawei's technology in early years."

(Interview, B.2)

Besides these, Huawei had no significant technological capabilities to develop initial technology, and due to its small size had only very limited possibilities to attract qualified engineers. This left Huawei with a limited choice in technology strategies. The firm was too small to be selected as a viable JV partner, and lacked the financial means to buy into foreign technology – therefore ruling out a dependant strategy.

Huawei's initial years had been more characterised by struggle for survival than striving for technological excellence, a development that tipped after 1989 when the firm gain access to more technology via their involvement with Shanghai-Bell. However, even at this point in time Huawei was perusing an imitative technology strategy at the lower end of the technological totem pole.

Huawei benefited from engaged leadership that understood the needs and requirements associated with learning based technology strategy and was willing to invest in it.

“Huawei has always benefited from the entrepreneurial spirit of its management [...].”

(Interview, B.5)

National Institutions

During the first period of technological development Huawei’s ownership structure impacted the firm’s interaction with the institutional environment, which looked less favourable at POEs than they did on SOEs. As previously mentioned, this impacted the firm’s ability to access markets, money, technology, and labour through institutional restrictions. This in turn limited the choices in viable technology strategies available to the firm. Huawei lacked the access to international technology and the financial resources to choose an initially costly dependent technology strategy. Most importantly, with the firm operating in a key strategic industry there is a lack of government support to become a JV partner in the first place. Limited internal resources also ruled out any complex international-imitative strategy as a viable option for the firm at this particular stage of development, hence a domestic-imitative strategy was the only workable choice at this time. However Huawei’s access to international technology changed in late 1989, when the firm recruited the Shanghai-Bell JV as a third party supplier.

“Working with Shanghai-Bell helped Huawei to develop and was a great learning opportunity for us. Working closely with one of the leading ICT firms at the day gave us an insight into the workings of the ICT industry. [...] Being part of the supply chain of such a big firm is beneficial for a new firm in the market.”

(Interview, B.1)

Working with Shanghai-Bell also represented an important learning opportunity for the firm, due to the JV pushing to fulfil its agreed localisation percentages from an early stage on and by 1995 achieved a 70 per cent rate of localisation (Thun, 2015). Further, Huawei’s size was a factor during its initial period of technological

development, with the firm being very small and hence only having limited resources at hand to pursue a more complex technology strategy. While the size limited the choice in technology strategy, it was ultimately beneficial for the firm's development as it allowed Huawei to develop under the radar of direct government influence.

In summary, Huawei's starting point in its technological development was far from being privileged due to being a small private-owned enterprise in a key strategic industry, yet its ownership structure did convey some advantages.

Technology Strategy

Internal resources the firm had been limited due to the restrictions associated with its small size and technological type. At the same time, the external resources have provided a more complex set of advantages and disadvantages for the firm.

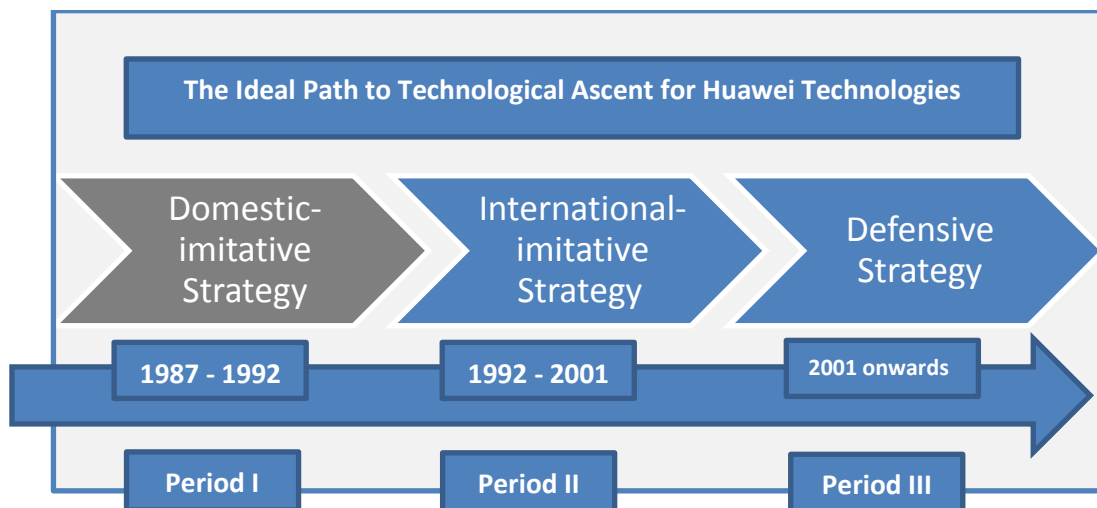
The coastal location was advantageous in its proximity to key players of the ICT industry. It allowed Huawei – irrespective of its small size and private ownership status – to access not only the initial domestic market but also existing supplier networks and labour markets. Huawei also benefitted from the greater infrastructure developments and other associated spill over effects resulting from the 'hub' effect in Shenzhen. Most importantly this allowed for the acceleration of Huawei's technological capabilities through learning and unbundling existing technology.

In this case the firm's small size was actually working to its advantage. It allowed Huawei to enter the market as a low-key distributor and supplier without causing too much of attention. During its initial stage of development Huawei was not perceived as a significant threat to SOE's. Therefore despite operating in an industry of strategic importance, they were not subject to any government or competitor instigated protective measures. At the same time the fast growing ICT industry and buoyant domestic market allowed for substantial revenue, even at the lower end of the technological spectrum. Huawei was able to capitalise on this opportunity to both expand its basic set of technological capabilities, and amass enough profit to support further internal R&D activities. This in turn facilitated the firm's second development period, which involved the move to a more challenging international-imitative

technology strategy – and saw Huawei evolve from distributor to manufacturer with a strong focus on rural China.

5.3.6 Huawei Technologies – Development Period II from 1992 onwards

The first development period of Huawei ended after five years in 1992 and was succeeded by the firm’s second stage of development lasting until 2001. During this seven-year period Huawei transformed from a small domestic switch supplier mainly focused on the Chinese rural markets to an established player in the ICT industry operating on an international scale. The focal turning point in 1992 was Huawei’s jump away from domestic sources of technology and successfully developing its first digital switching products based on foreign technology. These products reflected Huawei’s first technological jump in capabilities moving the firm forward on its ideal path to technological ascent.



The time period from 1992 to 2001 was characterised by Huawei pursuing an international-imitative technology strategy. This change in technological strategy was marked by Huawei’s access to international technology through the Shanghai-Bell joint venture and its first evidence of having applied the obtained unbundled technological capabilities in its new digital switch products.

“One key moment in Huawei’s development was the launch of its digital switch technology developed for the Chinese rural market. It was not only a technological but also economic success for the firm that paved the way for its future development.”

Another key aspect of the second development period was the firm's decision to focus its sales efforts onto the rural markets rather than the fast developing more advanced coastal areas of the reforming China. This decision allowed Huawei to operate in a market that as, albeit not technically protected from foreign competition, but due to a multitude of reasons that will be discussed in more detail below, almost completely free of domestic and foreign competition.

Firm characteristics

The configuration of Huawei changed considerably from the first period of development reflecting the firm's evolution during the first five year of its existence. As previously mentioned Huawei started with no to little technological capabilities and managed to overcome the first hurdles of unbundling its first set of initial technological capabilities within only a five-year period. As a result, the setup of internal resources, most notably its labour relations and organisational capabilities, changed in accordance with the firm's moving forward on the path to technological ascent.

Huawei's management stayed a consistent point in the firm's internal resources with Ren Zhengfei continuing to lead the firm as an engaged private owner committed to growth and technological development. Huawei benefitted greatly from the insightful and engaged managerial team during this period of development as its ability to understand the uniqueness of the Chinese domestic market and anticipating the market needs gave the firm a strong advantage over both its domestic and foreign competitors. Huawei's management played a clear role in the success of the firm's development. Firstly, they identified a market niche within their technological reach, which was characterised by only limited competition from both domestic and foreign firms. As most large SOE domestic firms tied up in joint-ventures with foreign firms been focused on the booming coastal areas and securing technology transfer, they left the rural market untapped and disregarded it as uninteresting. This can partly be explained by politically motivated SOE management that was trying to achieve prestigious success in advancing technology in the coastal areas in order to secure political promotion, rather than venturing off the political epicentre into the Chinese

hinterland. For foreign firms the rural markets been inaccessible as their high-end and expensive products did not meet the market needs and lacked the desired local adaptation, such as a simple to operate user interface in Chinese characters rather than English. Secondly, by moving away from the competitive and politically high profile markets in the coastal areas and reverting inland to less noticed rural markets, Huawei managed to find a place free of immediate competition that allowed the firm to grow. Further, it once more made the firm operate in a way that it neither triggered the envy or attention of political entities or competitors and by doing so avoiding any unwanted political interference in its technological development.

“Large domestic markets act as an incubation space for domestic firms, but only if they are protected from external Western competition, this has been the case for Huawei in the 1990s. They moved to the less developed rural areas of China which offered a large domestic market, which was free of excessive foreign or domestic competition.”

(External Interview, 12)

Thirdly, the firm’s management anticipated the rural Chinese market needs in a way setting it apart as it offered lower cost and sturdy switch technology suited for the needs of less developed Chinese rural markets. Huawei’s products outperformed more advanced Western products in its rural settings as they had been more adapted and sturdy, for example the switches resilience against network fluctuations or in more simple terms having thicker plastic insulations to withstand attacks from rodents. This market turned out to be of enormous growth potential and an unparalleled cash generator for Huawei.

“Considering that Huawei started targeting the rural markets in 1992 with its specially designed rural solutions it is worthwhile to emphasise that only three years later, in 1995, the firm generated sales in the volume of RMB 1.5 billion. The sales growth in these years was beyond anything the firm had ever seen and was an incredible success for us.”

(Interview, B.5)

“It was the rural markets that made Huawei in the 1990s. If it would not have been for these markets, Huawei surely would not be in the same position it is today. The sales success solved any financial worries of the firm within 12 months and opening doors that had been unthinkable of only a few months back.”

(Interview, B.2)

The resulting success in rural areas and its substantial inflow in cash allowed the firm to fund further research and development and to follow a more complex and challenging international-imitative technology strategy. Further, Huawei started at a very early stage in its technological development to seek external support in the form of Western consultancies and service providers.

“Huawei believes in continuous learning and reaching out to others to support learning. We have well established working relations with various external firms from consultancies to research cooperation in various fields and countries. [...] We have been working with IBM since the late 1990s and still do so today on various occasions.”

(Interview, B.1)

This seeking for support covered a wide range of topics and went far beyond only accessing advanced technological capabilities but also covered areas such as management techniques, HR policies, and accounting strategies. Again this was a management driven decision that is rather unusual to be found in Chinese firms of this day and age.

Huawei's success eased the firm's *labour* problems to a degree as it made it easier for the firm to recruit qualified *labour*. Huawei struggled to compete for qualified labour against SOE firms that offered stable and secure employment, whilst foreign joint-venture firms offered higher wage levels and prestige as an employer.

“Working for a foreign firm is something graduates are striving for as it is seen to be of advantage for the future career development if one has a well-known foreign employer in their CV. Plus there is the aspect of personal pride – people feel pride in working for a reputable Western brand – especially if it is one associated with emotional or luxurious products such as cars or fashion.”

(External Interview, 18)

The growing success in the market allowed Huawei to not only build a reputation as an employer, but also to offer higher monetary incentives due to their improved overall financial situation.

“Huawei’s levels of financial benefit are above industry average and allow us to attract the most talented and qualified people. Beyond that Huawei is an employer that people are proud to work for as it is a brand of international significance and status.”

(Interview, B.2)

Further, the coastal location of the firm is beneficial as it allows Huawei to take advantage of spill over effects of the wider industry present in the area. The close cooperation with local suppliers of JV firms further fosters technological spill overs, for example through poaching experienced employees. In later stages of the second development period, Huawei managed to capitalise on its unique management structure and overall corporate philosophy to generate low levels of employee turnover. The employee ownership concept that Huawei offers functions as tool to bind employees into the firm due each employee being a shareholder and as such creating a personal interest into the firm.

Huawei’s organizational capabilities also developed in line with the overall changed the firm as undergone during the first period of technological development. Huawei has matured as a firm, moving away from more opportunistic business behaviour with a focus on survival towards a more established one. This was mostly rooted in the firms new found financial security that allowed for more to be given onto their technological capabilities and their development.

“Huawei’s development gained pace in the mid-1990s, once we had overcome the first problems of setting up business, and secured a solid markets share that enabled us to grow and focus on the future.”

(Interview, B.4)

This shift in overall goal for Huawei was driven by the management team of the firm which due to its committed and knowledgeable owner leadership was willing to pursue a long-term goal even at the cost of short-term revenue.

“We setup our first R&D centre as early as 1999 – in India – and many more followed quickly onwards in various countries worldwide. By now we do have 16 R&D centres worldwide in various locations, such as Germany, Sweden, and USA, just to name a few and about 45 per cent of our total work force is in R&D related positions.”

(Interview, B.1)

The level of commitment to developing the firm’s technological capabilities is reflected in the firm’s strong investment into R&B both within the firm and China and outside of it through various research centres, such as Bangalore (1999), Stockholm (2000), and four US based R&D centres (2001). The pace and volume of these investments reflect a clear and strong commitment towards the development of the firms technological capabilities. As a result the technological capabilities of Huawei did develop significantly since its founding in 1987.

National Institutions

In opposition to Huawei’s internal resources the external ones stayed with the exemption of the firm’s size largely unchanged. However, the way they impacted the firms interaction with the institutional environment changed as the firm progressed through its second period of development. As for the internal resources, the second development period is characterised by very fast growth for Huawei and this is most obviously reflected in the change of the firm’s size.

Huawei’s location stayed unchanged and with it its associated advantages for the firm of being located close to the stronger developed coastal areas in the centre of the Chinese ICT industry. However, the changed overall configuration of Huawei allowed the firm for a different form of interaction and to more effectively reap the location benefits.

“Huawei returned to the metropolitan areas of China in the end 1990s as a different company. We had become a renown and accepted manufacturer of ICT equipment within the industry and been well positioned to compete even in the more demanding cities – thanks to our good customer service, tailored solutions around customer needs, and competitive price.”

(Interview, B.2)

Whilst during the first period of development Huawei had no chance to stand the fierce competition of established SOE and foreign firms in the coastal areas, it has grown and matured to face this challenge. In 1998, five years after its launch into the rural markets of China, Huawei returned to the coastal areas to continue its expansion within China. By turning to rural China with its low levels of competition as a market, yet having the operations located in the coastal areas with good access to technology, labour, and supplier networks – Huawei managed to combine the best of two worlds. It benefited from the limited competition in the rural areas whilst not being afflicted with the disadvantages of a rural location such as limited access to qualified labour or Western trained supplier networks.

“Huawei’s move into the rural areas of China was a great success for the firm, but it often goes unmentioned that it was that only since 1991 that local and provincial governments been granted the autonomy to award contracts to companies of their choice. A change in political practice that allowed Huawei to enter the rural market in such a scale in the first place”

(External Interview, 14)

It was this change in institutional environment that levelled the way for Huawei to access a new and prior closed market, an opportunity the firm’s management captured at a very early point in time. Prior to the granted autonomy to local and regional governments, all contracts had been centrally managed by the Ministry of Post and Telecommunications (MPT) which resulted in SOE firms being strongly favoured and factually closing the market for POEs (Harwit, 2008). Further, the firms move away from the coastal areas also meant less state intervention as it was easier for Huawei to develop unnoticed from competition and political entities. Furthermore, Huawei

worked closely with many local and regional government entities during this development period and by doing so was able to gradually build up regional government support to strengthen its position within the ICT industry as a private owned firm.

This leads us to Huawei's *ownership* structure and how it developed during the second period of technological development. The overall ownership structure stayed unchanged with Ren Zhengfei as the owner and managerial leader of the firm. As during the first development period, Huawei continued to be a rather unusual firm to operate in what is considered to be a strategic pillar industry (支柱产业 – zhizhu chanye).

“Huawei is an unusual firm to be found in the ICT industry at the time, as in the Medium- and Long-Term Science and Technology Plan released by the Ministry of Science and Technology the ICT sector was listed as one of those of primary interest to the state and as such SOEs should retain full control.”

(External Interview, 13)

The firm is an independent private owned company with limited political affiliations at this point in time. As previously mentioned Ren Zhengfei was not a Party member due to his family affiliations to the KMT, and only started to gradually build local and regional government support during its rural expansion. However, Ren Zhengfei's personal network proved to be beneficial for Huawei, as for example one of the first rural contracts secured was a local government one believed to be obtained by Ren through personal relationship (Harwit, 2008). This initial government contract triggered further provincial and local government contracts sparking the fast paced development of Huawei. The success in rural areas allowed Huawei to overcome the ownership disadvantages associated with private-ownership in China in terms of access to finance and market. As the rural market was largely disregarded and as such free for Huawei to pursue and generated the much needed financial revenues to fund the firm's future development. Further, there was little central government interference to be expected as Huawei was flying under the radar of the central and coastal regional governments operating in inland China.

“Huawei benefited greatly from close cooperation with both local and regional government entities during its development, not only as our customers but also in terms of business support.”

(Interview, B.2)

As previously mentioned, this gave Huawei time to gather local and regional government support in rural China whilst simultaneously growing in size and economic importance in order to become too big to fail. Moreover Huawei’s focus on rural China helped to overcome the lack of state support and beneficial treatment that the firm would have faced operating in coastal areas in which the institutional support was focused on SOE firms.

During the second period of its technological development, Huawei managed to mostly overcome *and size* issues and become a medium/large sized firm. This gain in size and strength in market foothold allowed Huawei to return to the coastal areas of China and compete with larger SOEs and foreign firms.

“Huawei has continuously grown since its founding but most notably during the fast growth periods of the 1990s and 2000s, which saw the firm expand at a fast pace in both numbers of employees and sales.”

(Interview, B.1)

Further, the gained size helped to overcome several of the disadvantages associated with being a privately owned firm in China such as access to markets, finance, and mostly qualified labour. During the first period of technological development, Huawei struggled to secure qualified labour due to its small size and the resulting impression of being a less secure and less prestigious job. Generally speaking the increased size of Huawei helped the firm to cope with the wider uncertainties as it had the needed financial resources to withstand market pressures better than a small firm could.

The role of the industry played a key role in the second period of technological development for Huawei. It was the substantial growth potential of the industry in both the more developed coastal markets as well as in the more underdeveloped rural ones that strongly influenced Huawei’s successful technological ascent. It was the

firm's successful expansion into rural China that generated the sales revenues they urgently needed to fund the firm and also their technology strategy.

“The rapid development in the Chinese telecom sector allowed for strong growth opportunities that allowed firms like Huawei to progress in an equally impressive speed. [...] The sheer potential and volume of the overall market fuelled an unparalleled period of growth and with it being a more disruptive industry compared to more traditional manufacturing ones, allowed firms to become successful and gain market share quickly”

(External Interview, 13)

Moreover, due to the fact that within ICT manufacturing the needed technology is rather easy to copy and reverse engineer helped Huawei to fast overcome their gap in technological capabilities and bring them into a position to offer a competitive product within the market. Further, to the aspect of sales volume and revenue did the large domestic market in the sector helped to facilitate the technological upgrading process for Huawei. The fact that the rural market has been left largely untapped by both SOEs and foreign firms allowed Huawei to jump into the niche and secure the sales volume and by doing so also secured technological learning opportunities.

Period II Summary - Impact of firm characteristics and institutions onto firm's technology choice

As previously discussed internal as well as external resources impact the firm's choice in technological strategy and have a resulting influence on the firm's path to technological ascent. During the second period of development the set-up of both external and internal resources had changed in comparison to the ones faced with during the first stage on its developmental path. As a result their impact on the chosen technology strategy has evolved as well and helped Huawei to move away from a simpler domestic-imitative strategy to a more ambitious international-imitative one.

Firm Characteristics

As far as internal resources are concerned, Huawei developed away from being a switch distributor towards becoming an ICT equipment manufacturer during the first

period and successfully accomplished this transition with the start of the firm's second developmental stage. It is worth stressing that Huawei managed to achieve this significant step from distributor to manufacturer within only a 5 year time period, which even in an easier to imitate industry like ICT is an impressive accomplishment.

“Huawei’s development is characterised by an impressive pace – if you think about it the firm managed to move from start up to established leading domestic player within less than 10 years and further managed to jump into an internationalisation strategy shortly after. Only few firms can display such a fast transformation in their history.”

(Interview, B.5)

As stated in the above quote, the fast development within the market allowed Huawei to secure a substantial share of the rural domestic Chinese market with even limited technological capabilities. It was this market share that generated the much needed cash flow for the firm to pursue its further ambitions in technological growth and is one of the key changes in the internal resources available to the firm.

“The launch of our digital switching technology aimed at the Chinese rural markets and its resulting success in the following years was a milestone in Huawei’s history. It was a great commercial success and the results helped to develop the company further both technologically and strategically [...].”

(Interview, B.1)

This new found financial security and freedom freed considerable levels of managerial capacity for Huawei. During the first period of technological development the monetary aspects of the firm's internal resources more often proved to be rather complicated as they lacked access to external capital to fund any technological or strategic expansion plans. This was further emphasised in the before mentioned quote and continued as below:

“[...] It was the revenues out of the success in the rural market which allowed Huawei to heavily invest into R&D and its technology base in the late 1990s.”

(Interview, B.1)

The new found financial strength allowed Huawei to pay higher financial incentives to qualified labour which placed them in a more favourable position within the labour market and the competition against state-owned and foreign firms. The considerable economic success in the Chinese domestic market moreover helped to establish Huawei's reputation as a serious player within the Chinese ICT industry which helped to further strengthen the firm's position in the labour market.

The firm's success and fast paced growth did not only change the way the firm was perceived within the industry and labour market but also changed the firm's interaction with the wider institutional context in China. Not only did the increased size of the firm allowed Huawei to better negotiate their position against institutional counterparts but also due to the firm's management that at an early stage started to rally local and provincial government support for the firm. The active pursuance of the management to gain this support again proves the high levels of engagement and understanding of local market needs of Huawei's managerial team.

"Huawei's success is driven by our leadership – a leadership that defines the companies' vision and direction."

(Interview, B.1)

This behaviour is believed to have been initiated and strongly supported by Huawei's founder and owner Ren Zhengfei (Harwit, 2008; Zhang & Duysters; Thun, 2015). Albeit Ren Zhengfei did not have any direct party affiliations, he had been able to build a considerable network of private relations within the ICT industry in China during his time as an engineer in one of the PLA's ICT research divisions.

"Values play a key role in Huawei's leadership and our management is strongly guided by these. Our key values are: communication, relationship, humble leadership, value-driven leadership, and a productive vision."

(Interview, B.2)

Further, the firm's engaged leadership understood the needs and requirements associated with a learning based technology strategy and been willing to invest into learning. This allowed Huawei to achieve a significant jump in its technological

capabilities during the second period of technological development. During the later phase of the second period, this was in parts fuelled through the firms continuously improving access to foreign technology through different alliances. Throughout the earlier stages of the firm's technological development the access had been limited, yet the firm's utilised the little access it had and focused on continuous development of the technological capabilities as they unbundled the obtained technology.

Huawei not only managed to promote its technological capabilities but also achieved a wider shift and upgrade in its organisational capabilities by very early in its development seeking help from both outside the organisation and China, for example by hiring Western consultancies.

“Huawei and IBM have a longstanding cooperation and their guidance has contributed in great ways to the organisation as it is today. We at Huawei believe in continuous learning and that enables us to grow as an organisation and offer our customers the products and services they require.”

(Interview, B.5)

From 1998 onwards, Huawei hired IBM consultants to re-organise and update the management system and processes. This shows that Huawei not only focused on the technology side of knowledge and innovation but also considered the need for appropriate management structures during the firm's development process. As previously mentioned the pace of development during the second period of Huawei's ideal path to technological ascent was unparalleled in the firm's history with revenues doubling year on year for almost five years in a row. Such figures would usually not call for the need to assign external help but rather could be seen as a sign of great success. However, Huawei's management acknowledged the shortfalls in the firm's wider organisation which gives a strong indication on the firm's level of openness for senior management to Western and external influences and their proactive approach on management.

Huawei's interaction with key national institutions represents a mixed picture during the second period of technological development as the aspects of location and ownership stay unchanged while size and industry evolve. However with the firm's size

and industry position changing it also changed the way the two consistent resources impact on the firm's technology strategy as its interaction with these external resources changed due to its increased size and importance in the industry.

One of the key influences on Huawei's choice in technology strategy, as far as external resources are concerned in the second period for technological development was the industry sector the firm operated in. The enormous growth potential of the domestic market within the ICT industry gave Huawei the possibility to generate substantial amounts of revenue and cash inflow through the firm's success in the domestic rural market to overcome a multitude of issues faced during its first development period. Firstly, the financial situation changed fundamentally for Huawei and by doing so lifted several limitations from the firm in regards to their choice in technology strategy. Huawei was able to follow a more challenging and long-term focused technological strategy as the firm now had the financial resources to commit to the needed investments that come along with this choice. Secondly, the vast industry growth was also reflected in the firm's equal expansion in size which turned Huawei from a small distributor into a large ICT equipment manufacturer in the domestic Chinese market. Thirdly, the expansion in rural China helped the firm to rally institutional support in local and regional level in order to overcome the disadvantages associated with private-ownership. In summary the financial and market success Huawei was able to secure due to the vast development of the Chinese domestic ICT industry itself change the whole set up for Huawei and its perception within the wider institutional context of China. This in turn of course influenced the firm's technology strategy choices as the firm was now better placed to follow a more aspiring approach on technology.

As previously mentioned above, during the second development period Huawei's size changed significantly and the firm managed to transition from being a small firm operating on the fringes of the ICT industry to a well-established domestic equipment manufacturer. The firm doubled its size almost year on year and grew consistently throughout the second period of technological development.

“Huawei has continuously grown since its founding but most notably during the fast growth periods of the 1990s and 2000s, which saw the firm expand at a fast pace in both numbers of employees and sales.”

(Interview, B.1)

“I would say the fastest growth period for Huawei in pure numbers was in the mid and late 1990s. During this period the pace of growth was incredibly fast and happened more or less overnight, whilst the still consistent and good growth of the 2000s was more linear and more manageable.”

(Interview, B.3)

This was also reflected in Huawei’s perception within the wider industry and the institutional context as the firm turned from a small industry underdog to a firm of national significance which made it too big to ignore or let deliberately fail. In the mid-1990s, the Chinese central government had started to take notice of Huawei and its success in the domestic ICT market, albeit government support was largely absent during the first period of technological development it did become of significance during the second and third. In 1994, Ren Zhengfei met Jiang Zemin the then Chinese President of head of the party, during which Ren Zhengfei claimed to have stated:

“Switching equipment technology was related to international security, and that a nation that did not have its own switching equipment was like on that lacked its own military. Secretary Jiang replied: Well said.”

(Harwit, 2008 p.128).

Further, the change in size of Huawei positively affected the access to foreign technology and allowed the firm to boost its technological capabilities quickly by unbundling the obtained technology and integrating it into its wider skill set. A practice that paid off during the second development period and came to results in the great success of the firm in the Chinese rural markets and helped to overcome Huawei’s initially small size which been a limiting factor for the firm during the first period of development.

In summary, during the second period of technological development Huawei managed to overcome the limiting aspects of both the internal and external resources that impacted the firm during the first developmental period. Huawei started from a disadvantaged point in regards to size, financial resources and ownership into the second period of its technological development and as previously elaborated, this was still impacting the firm in the early stages of the second technological development period. Key for overcoming these limiting aspects had been Huawei's venturing into the Chinese rural markets in the course of the second part of the firm's path to technological ascent as it helped to overcome the disadvantages faced in size and access to financial resources as well as outbalancing the negative impacts of being privately owned within a strategic industry in China.

National Institutions

This had only been made possible by a change in governmental practices which transferred autonomy in the purchasing decisions for ICT products from the centrally government Ministry of Post and Telecommunications to the individual local and regional subsidiaries. This allowed Huawei to tap into a market segment with limited competition due to the several external factors of the market itself. SOEs at that time disregarded the rural areas due to the fact that the coastal area development enjoyed political priority and allowed for better ways to foster the political careers of those in charge at SOE management level. On the other side, those foreign firms operating in China been mostly bound to SOEs for the local market experience and due to their lack of knowledge and suitable low-cost and robust product preferred to focus on the more advanced coastal areas as well. This left Huawei with a market segment with limited competition and allowed the firm to grow not only in size but also at the same time to overcome its financial restrictions. Huawei being a private-owned firm it had only limited access to the state led Chinese financial market an aspect that significantly impacted the firm and its choice in technology strategy in the first period of development.

This firm's rural success can be attributed to two key aspects, firstly the overall industry growth that allowed for Huawei to expand at such rapid pace in the first place. And secondly, Huawei's engaged and knowledgeable management team that at a very early

stage anticipated the potential of the Chinese rural market and its particular needs and requirements towards their ICT products. It was them who managed to lead Huawei into the rural market nice at the right time offering the right products and services allowing the firm to reap the much needed sales revenues to grow.

“Accessing external finance through the usual channels was something that was almost impossible for private-owned firms back in the days. Meaning if a private firm wanted to invest, they needed to be able to generate the needed cash internally either via their owners or sales revenues.”

(External Interview, 12)

“For Huawei the customer always comes first – this has always been our business model – our products and services are developed around the customer’s needs and not around the behaviour of our competitors.”

(Interview, B.1)

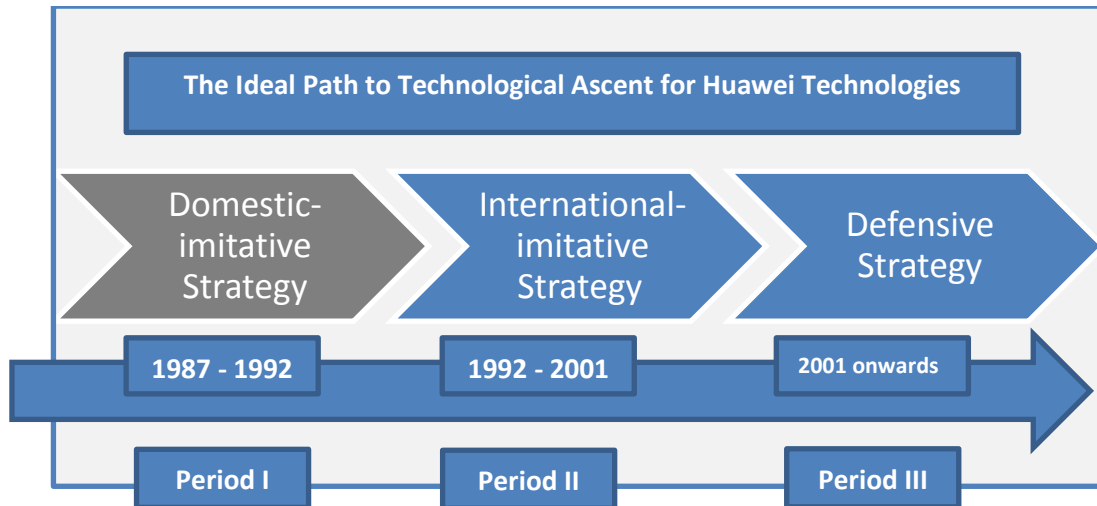
Technology Strategy

Finally, this development allowed Huawei to develop technologically as they had better access to foreign technology due to their bigger size and reputable stands within the Chinese ICT industry. Further, the firm’s improved financial resources allowed to fund a more challenging imitative technology strategy in the long term as it permitted for low visibility investments into learning that have a slow ROI. Last but not least, Huawei managed through its rural expansion to not only rally local and regional government support but also to become too big to fail resulting in central state support opening the doors for Huawei to preferential state treatment further boosting the firm’s development.

5.3.7 Huawei Technologies – Development Period III from 2001 onwards

The third period of technological development for Huawei Technologies begins in 2001 and continuous to this point in time. At the turn of the century, Huawei started to move away from an international-imitative technology strategy towards a defensive one transitioning from an imitating to an innovating firm. As of 2001, Huawei’s chosen technological strategy can be described as a defensive one leaving behind the previous

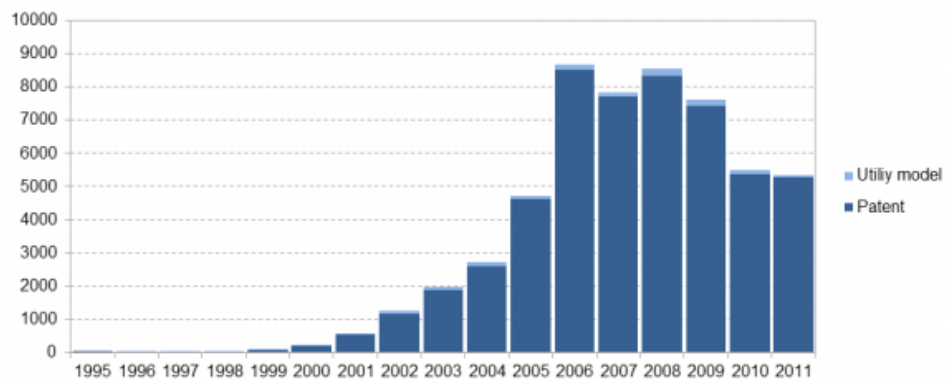
international-imitative orientation of its development. This change in tactic is a key event in the firm's ideal path to technological ascent as it marks the successful transformation from imitated technology being unbundled and applied into original innovation and technological capabilities.



This process was opposed to the technological shift between first and second development period not of revolutionary but rather evolutionary nature as it cannot be directly attributed to a landmark event in the firm's history. However, the year 2001 stands out in the technological development path of Huawei as the year where it filed its first significant amount of patent applications as can be seen in the below graphic. Further, the same year is the starting point of Huawei's internationalisation push into established Western markets with first contracts being secured in the Netherlands, France, and Germany (Ahrens, 2013). This first patent application can be interpreted as a sign that Huawei had technologically matured and needed to protect its own technological achievements from imitation of other firms in the sector. Similar to the previous TMT case discussed, it can be argued that China's WTO entry in 2001 did spark the patent applications of the firm as with the WTO entry the awareness in China for IPR and the need for patent applications was raised (Huang, 2003; Blancher & Rumbaugh, 2004; Yu, 2006). While this study again acknowledges this argument it argues that Huawei already started to file for patent applications as early as 1999. However the numbers of patents applied for been rather low and it was from 2001 onwards that the numbers of patent applications reached a number that can justify

arguing for a consistent change in technology strategy away from imitation towards innovation. In the years from 1999 to 2001 the numbers of patent applications been rather low and the chosen year still represents the fairly early beginnings of Huawei's development as a defensive technology strategy firm.

Table 26: Huawei Technologies Co. Ltd. – Patent & Utility Model Applications by year



Source: „China Innovation“ – Comparing Worldwide Patent Portfolios, www.china-innovation.de, Study of the Munich Innovation Group and TU München, calculated with EPO Worldwide Patent Statistical Database (PATSTAT), Licensed by OECD/EPO Taskforce on Patent Statistics.

Looking at the above graphic of patent and utility model applications for Huawei gives a good overview on the firm's pace in technological development. The first significant application numbers started to materialise in 2001 with the figures doubling and breaking the 1000 patent mark in the year after. From 2001 onwards, Huawei's patenting activity had been of a rather consistent nature with numbers steeply increasing in 2005 and 2006. Starting in 2006 the pattern of patent applications starts to become more erratic which is related to the technology cycles in the telecommunications industry, for example the upgrade from 4G to 5G technology which causes spikes in the research activity of ICT firms (Ahrens, 2013).

Firm characteristics

It is stating the obvious that Huawei has changed significantly over the third period of technological development and as such also have the internal resources of the firm. During the early stages of the third development period Huawei moved away from being a domestic Chinese ICT manufacturer and pursued a fast international expansion strategy. This of course affected the firms primary goals and therefore also the firms organisational and organisational characteristics. Further, as previously mentioned Huawei at very early stages focused not only its technological development but also on

its organisational one which resulted in changes of the internal resources during the third period.

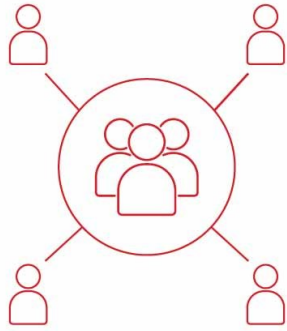
Starting with the management set up of the firm, Ren Zhengfei still is the key figure in the leadership of Huawei. However with the firm grown so substantially in the second and third period of its development the managerial team around Ren has grown significantly. During most of the third development period Ren Zhengfei stayed the sole CEO of the firm and strongly influences the management strategy of the firm. In the 2011 Annual Report Huawei announced the implementation of a rotating CEO system, in which the firms four Deputy Chairmen of the Board – Ren Zhengfei, Guo Ping, Xu Zhijun, and Ju Houkun – serve for rotating six months terms as CEO (Hauwei, 2011).

“Huawei’s leadership structure is unique in its configuration as a rotation system. Huawei implements a system of rotating CEOs under the supervision of the Board of Directors with each of the Deputy Chairman functioning as the rotating and acting CEO for a six month tenure.”

(Interview, B.1)

“The rotating CEO system is admittedly unusual but in my opinion a very good approach on management as the firm can benefit from the expertise and insights of four leaders. To my understanding the respective acting CEO chairs the firm during his tenure in the routine management decisions and reports to the Board of Directors if needed.”

(Interview, B.2)



Huawei's rotating CEO system

In this system three deputy chairmen act as the rotating and acting CEO for a tenure of six months and form a board of seven together with four standing committee members.

All three members of the rota are longstanding members of Huawei and joined the firm at very early stages of development and therefore have a deep understanding of both the firm's technology and their organisational structure¹³. It needs to be pointed out however that the titles of the four members still differ slightly with Ren Zhengfei still being referred to in Huawei communications as CEO, whilst the remaining three members are addressed as Rotating CEOs. A minor but especially in China significant difference in policy that would indicate that up to this day Ren Zhengfei to a large degree influences the firm's managerial decisions¹⁴.

Huawei did not provide any elaborate justification for the unusual choice in managerial leadership structure but – given Ren Zhengfei's (71 years) age – a strategic managerial approach on ensuring a smooth transition in succession once Ren Zhengfei should leave the firm. This is of particular importance as the firm's success has been closely connected to the Ren Zhengfei's individual leadership style as a CEO.

In regards to Huawei's employee constraints one of the key changes in the third development period was the change in the firm's employee stock ownership plan (ESOP) which closer linked the firm's net assets to the dividends paid to the shareholding employees. This change in ownership structuring has been discussed in length in the ownership section of this chapter. However in regards to internal resources of the firm it needs to be stressed that the changes in the ESOP helped Huawei to quickly integrate the large numbers of new employees taking in during the third period of development.

¹³ The members of the CEO rotation system all joined Huawei from a very early stage onwards: Guo Ping joined 1988, Xu Zhijun in 1993, and Ju Houkun in 1990 according to Huawei's public communications. Further their tenure is communicated publicly and currently stands as follows: Mr. Hu Houkun: October 1, 2014 – March 31, 2015; Mr. Xu Zhijun: April 1, 2015 – September 30, 2015; Mr. Guo Ping: October 1, 2015 – March 31, 2016 (Huawei, 2015).

¹⁴ Industry experts assume this also because of the 6 months tenure of each rotating CEO being rather short to actually influence any significant managerial strategies; hence it is presumably Ren Zhengfei who still has the final vote on any decision of wider strategic importance.

“Huawei is growing fast and – we are looking at 10.000 new employees a year – it is a challenge to integrate these numbers into corporate culture and align targets and vision of Huawei with the individual employee. The employee stock ownership program is a great way to achieve this target and to help employees to be proud of the success of their firm as well as having the individual reward for their hard work.”

(Interview, B.1)

“Being a shareholder gives it a different perspective. You are not only an employee working away on a project but you are actually working for your own company in a way. I personally find this motivating and like it. You are still working in a large multinational cooperation and yet you are not just a small potato (in Chinese: 小土豆 (小人物); meaning being a unimportant employee in a large firm) amongst many others, even if your day to day work might not reflect that.”

(Interview, B.4)

Further, Huawei’s successful development changed its position with the labour market and helped the firm to attract highly qualified talent through its multinational appeal, unique ownership proposition, and through its high levels of pay over its competitors.

“Huawei pays well and above average in the industry especially if you compare it to some of the salaries paid by SOE firms in the market. Plus, if you are working in Shenzhen and get subsidised accommodation there is an additional benefit in it. Food however on campus is quite expensive and I have heard this is cheaper in other firms.”

(Interview, B.5)

“Our graduate program is very popular and we are receiving on average 15 times more applications than we do have positions available. This is partly due to our reputation as an employer and also due to our great salary packages that stand at above industry average.¹⁵”

¹⁵ This comment was refereeing to the Chinese graduate program of the firm and average pay for graduates in China. No direct numbers have been given in any of the interviews but in Chinese

(Interview, B.1)

Even at these higher levels of pay Huawei still enjoys a financial competitive advantage in regards to its labour cost structure over its more established Western counterparts. Further, working hours at Huawei are long by Western standards and it is not uncommon to work weekends at no extra charge. This is an additional effect of the ownership structure where overtime is expected and any additional work often is indirectly required through management.

“It is a good firm to work for but I know that in comparison to other firms we work long hours. Some of my classmates working in other companies have shorter hours – I think especially in state firms the working hours are better.”

(Interview, B.5)

In terms of Huawei's *financial* resources the situation has changed dramatically in comparison to the first development period, however for the better instead of the worse as the firm managed to increase its revenue steadily since 2006. The firm's sales revenue grew almost 50 per cent year on year between 2006 and 2008. Huawei pulled through the 2008 financial crisis with continued growth and sales revenue increasing from 18 to 21 billion US-Dollars, in contrast to the firm's international competitors who struggled to retain their financial stability.

“The results have been very good over the years and the development been a very positive one. Obviously Huawei has become a more international firm over the years and so we are also more affected by the developments in the world economy, if the worldwide economy is struggling, so are our customers, and ultimately this will reflect negatively on us. However our numbers have been very strong throughout the last ten years and proven the firm to be on the right track.”

(Interview, B.3)

employment websites the graduate payment of Huawei is stated to be around RMB 10.000 depending on the individual background.

“The financial crisis left Huawei largely unaffected with most firms having to accept negative figures of sales growth, Huawei managed to still grow its sales by about 20 per cent – quite the achievement – this was largely due to the strong Chinese domestic market that fuelled by government investment helped to soften the blow for the industry in China.”

(External Interview, 8)

Furthermore, Huawei from 2008 onwards led the industry in year on year sales growth with the majority of revenues generated in international markets (Ahrens, 2013).

Huawei’s technological skill set has been at the core of the firm’s business and been continuously expanded during the third period of technological development. As previously mentioned, starting from 2001 onwards Huawei started to steadily increase the number of patent applications and continued to strongly focus on R&D. By now Huawei runs 16 research institutes worldwide a trend that had been started with the first R&B centre in India during towards the end of the second technological development period and continuous to invest into R&D.

“We are spending around 10 per cent of our annual revenue on R&D and amongst the leaders in our industry in R&D spending. Innovation has always been a key target for Huawei.”

(Interview, B.3)

In 2012, Huawei announced to increase its R&D investments further and was targeting an overall investment of USD \$4.5 billion (approx. GBP 3.5 billion). By 2015, Huawei was spending around 15 per cent of its annual revenue on R&D, totalling to RMB 59.6 billion (approx. GBP 6.9 billion), and therefore significantly exceed the previously set target (Huawei, 2015). Further, Huawei’s technology base has been continuously expanding as well and the firm had 50.377 patents granted by the end of 2015 (Huawei, 2015). The firm became the Chinese domestic leader in patent applications in the year 2002, number fourth in the world, and became the world leader in patent applications in 2009 and since then stayed amongst the top three (Ahrens, 2013.)

National Institutions

The interaction with the national institutions for Huawei during the third phase of their technological development changed not only in their configuration but some also in their overall importance to the firm. The location aspect became less important for Huawei as a result of their internationalisation strategy whereas size and industry continued to be key influences on the firm's technological strategy. Further, the aspect of ownership started to become less of a domestic issue for Huawei with the firm gaining more and more institutional support in the domestic market but changed to become a disadvantage in some of the international markets which will be discussed in the section to come.

During the third development period of Huawei the overall impact of location onto the firm started to shift due to the change in the firm's sole domestic focus of operation being consistently internationalised. Huawei's headquarter is still in Shenzhen with the Huawei campus at the heart of the firm's operations. The campus is often referred to as the Silicon Valley of China and comprises not only office and research buildings but canteens, restaurants, employee accommodations, a hotel, sports clubs, swimming pool, hospital, and shops. It is a city within the city and Huawei is still benefiting from Shenzhen's good overall linkage to the Chinese ICT industry and its reputation as a manufacturing hub.

"The Huawei campus is a great place to work and it offers a much better working environment than most other firms."

(Interview, B.3)

"Huawei has close ties to Shenzhen and that is where its roots are and always will be. Shenzhen is a great place to be for us with a very qualified work force and good access to great universities and research facilities."

(Interview, B.1)

However with Huawei continuously expanding internationally during its third development period the importance of Shenzhen as a location factor in the firm's wider resource set up has been eroded. Huawei by now is a much more international

firm then it was in its first or second phase of development. The firm operates in over 140 countries and has multiple office and regional headquarters worldwide, meaning that due to its multi-office location it is less affected by Shenzhen as its main location, for example a shortage of skilled labour in China could be counterbalanced now by hiring people in other office locations of the firm such as India.

“We are an international company and are present globally. This gives us a great chance to tap into labour markets all over the world and be closer to where the newest research takes place. Of course we are still a Chinese firm but our products and our firm are influenced by worldwide trends.”

(Interview, B.5)

Further, the firm operates 16 research institutes worldwide and again this lessens the importance of the domestic location of the firm as the firm's activities are spread out more internationally than it used to be prior to the firm's expansion. Today, Huawei has about 110,000 employees worldwide of which 30 per cent work in Shenzhen (Huawei, 2015). The firm's progressed internationalisation strategy is furthermore exemplified in its overall sales structure with two-third of the firm's revenues being generated in international markets (Huawei, 2016). As previously mentioned, very early in the third development period of Huawei the firm's internationalisation started to take off and the period can be considered to be characterised by the firm's globalisation.

Huawei's ownership structure as such has not changed during the third development period. The firm restructured its employee stock shareholding program but essentially keeping its unusual ownership structure unchanged. Huawei became of greater importance for the national industry due to the firm's growing success and international expansion. This helped to counterbalance disadvantages in regard to preferential domestic treatment that usually is associated with this type of ownership. Huawei managed to close the gap to its state-owned domestic counterparts and became of the national government favoured firms.

“It was of benefit to the firm that the Chinese government had a great interest in getting the domestic ICT technology of the ground and to make sure they become technological independent form the West. Huawei very simply managed to get a decent set of technology at its hands fastest. It than did not matter that much anymore that the firm is private or state-owned, what matters is the technology and how badly the central government wants it.”

(External Interview, 8)

To give an example of the beneficial treatment Huawei enjoyed during its third period of technological development, from 2011 onwards Huawei financed its second major internationalisation push through extensive credit backing from Chinese state-owned banks. The China Development Band provided a credit line of USD 10 billion and the Export-Import Bank of China provided an additional USD 600 million (Ahrens, 2013).

Huawei’s unusual employee based ownership structure and its lack of transparency is causing issues for the firm in some markets, especially the Unites States (Harwit, 2008). The ICT industry is not only in China an industry of strategic interest, but also in many other countries around the world and hence national governments can react cautious towards Huawei as its ownership structure is not fully clear.

Further, the level of state support Huawei received during the third period of its technological development raised questions in the Western world and has the assumption rose that there is some level of state involvement within Huawei. The firms rather reluctant way of dealing with the rumours did not help rebut the allegations but rather fuelled the discussions and up to this point Huawei’s position in the US is weak.

“We are committed to transparency and we have external auditors, such as KPMG, who are verifying the correctness of our figures and are working alongside our board of directors. In that respect we are no different than any other shareholding.”

(Interview, B.1)

During the third period of technological development Huawei finally managed to successfully transition from a medium size to a large size firm within China. This

transition opened a lot of doors for Huawei in particular from a domestic point of view as Huawei now is considered to be one of the favoured firms within the industry. Further, did it allow the firm to seek cooperation partner internationally and hence created access to knowledge and technology that had been inaccessible to the firm in prior periods of technological development.

“Huawei is one of the leading firms in the ICT industry and not only within China but worldwide. We employ over 100.000 people in over 170 countries and we are still growing [...]”

(Interview, B.3)

“Does size matter? It makes a lot of things easier, I would say as a small firm there are many obstacles and challenges that bigger firms can much better overcome as they have more resources and are less vulnerable.”

(Interview, B.2)

In more general terms did Huawei’s growth in size also opened up the international markets to the firm as it secured national institutional backing and with it a strong support for the internationalisation of the firm. In summary, it can be stated that during the third technological development phase Huawei managed to overcome all the previous issues associated with the firm’s size.

The role of the industry in Huawei’s technological success evolved in a similar manner than the location one did during the third period of technological development. Huawei’s started internationalisation changed the role of the industry as an external factor from a purely domestic aspect to a more international one. With the firm being present in multiple markets and the majority of sales revenues generated overseas the role of the domestic market for the firm started to become less important. Huawei became less dependent on the Chinese ICT industry as the firm started to begin to increase its international operations. In 2001, Huawei secured its first major European sales in the Netherland, Germany, and France followed by further sales in European countries. Three years later Huawei secured the development of a 3G network for a

Dutch operator which was a considerable breakthrough for the firm and trigger follow up contracts in Europe.

“Building a whole 3G network in a well-developed Western country such as the Netherlands was a great boost for Huawei’s reputation. Up to this point most of Huawei’s larger international projects been targeted at developing countries.”

(Interview, B.5)

“The real breakthrough for Huawei in terms of internationalisation – I would say – had been the first bigger contracts secured in Europe. These helped greatly to overcome the China stigma that Huawei was still struggling up to this point. Nobody took Huawei fully serious back in the early 2000s and just saw it as a cheap alternative for the developing world and this view changed after these contracts been secured.”

(Interview, B.2)

By the middle of the third period of technological development, Huawei had managed to establish itself as a leading firm within the international market both established developed Western markets and less demanding developing ones.

Huawei’s new success gave the firm a new stance in the domestic industry as well, with Huawei overtaking the Shanghai-Bell JV in the Chinese market by 2002 which up to this point had been the market leader (Ahrens, 2013). This particular point is of interest as it marks the moment of the student becoming the master for Huawei as it overtook the very firm its first set of technology was derived of and which helped building its technological capabilities. However, Huawei also started to feel the downsides of its new size and growth by facing the competition of the bigger players in the industry.

“Locally speaking I would say that ZTE is our biggest competitor whilst internationally we are faced with the likes of Cisco and Ericsson.”

(Interview, B.3)

ZTE started to compete with Huawei on their home ground in the Chinese rural markets and quickly became a rival for the firm. Both firms are enjoying state support

through the national institutional set up, however ZTE is a state-owned but privately managed firm (Guoyu saying) which gives it an advantage over its usual SOE industry counterparts. This unique setup of ZTE places it right into direct competition with the privately owned and state supported Huawei and further raises the competitive forces within the industry.

Period III Summary – Impact of firm characteristics and institutions onto firm’s technology choice

As previously discussed internal as well as external resources impact the firm’s choice in technological strategy and have a resulting influence on the firm’s path to technological ascent. During the third period of development the set-up of both external and internal resources had changed in comparison to the ones faced with during the previous stage on its developmental path. As a result their impact on the chosen technology strategy has evolved as well and helped Huawei to move away from an international-imitative strategy to a more mature defensive one. This step marked the move for Huawei away from technological catch up to the firms’ arrival amongst established innovation firms within the global ICT industry.

Firm Characteristics

As far as *firm characteristics* are concerned, Huawei developed away from being a switch distributor towards becoming an ICT equipment manufacturer during the first period and successfully accomplished this transition with the start of the firm’s second developmental stage. It is worth stressing that Huawei managed to achieve this significant step from distributor to manufacturer within only a 5 year time period, which even in an easier to imitate industry like ICT is an impressive accomplishment.

The implementation of Huawei’s unusual managerial constellation of rotating CEOs allowed for consistency and a stable continuance of the firms technological development strategy. This avoided causing disruptions on the managerial focus of the firm through a fight over succession or even a complete break in its current strategy on technological development. Further the firm’s ownership structure not only allowed to quickly integrate large numbers of new talent and to grow the firm at such an impressive pace but also to retain a highly skilled workforce by tying them into the fate

of the company. In order for Huawei to successfully transition from an imitative to a defensive technology strategy it is of crucial importance for the firm to retain its talent and by doing so its technological skill set which is especially in an industry like the ICT of great importance (Michaels et al, 2014). Further, its unique ownership structure and overall success in the industry allowed Huawei to attract greater numbers of more qualified talent which positively impacted the implementation of such a more challenging technology strategy.

“It (Huawei’s ownership structure) is a great driver for many to join Huawei. It is something that sets us apart not only from our Western competitors but many domestic ones, too. Our setup might look odd to the Western observer but it makes a lot of sense from a Chinese point of view.”

(Interview, B.2)

Huawei’s financial resources further allowed for a challenging technology strategy to be successfully implemented as many of the shortcomings faced in respect to the firm’s technological skill set could be overcome. So did the firm invest substantial amounts in R&D and was able to offer above average remuneration packages to its key employees. The firm’s outstanding success of the previous years resulted in generous amounts of cash inflow to fund the firm’s new strategic goals (Interview I; III). Beyond this the Financial Crisis in 2008 had little to no impact on Huawei and left the firm unharmed in comparison to many of its international rivals that weathered the storm less successfully (Interview I; III). In summary, Huawei’s managerial consistency combined with its strong financial backing allowed the firm to attract and retain large numbers of highly skilled talent domestically in China and internationally, which allowed Huawei to successfully implement a defensive technology strategy.

Huawei’s third technological development period is characterised by the firm’s internationalisation and stronger outward look into the world. This change in overall strategic alignment of the firm had considerable impact onto the firm’s *interaction with national institutions* and the firm’s choice in technology strategy. By entering new global markets, Huawei also gained better access to more international external resources in regards to state interaction, finance, and labour markets resulting in the

importance of the domestic resources to be weakened within the wider global organisation of the firm. This is partly a logical consequence of the firm's internationalisation but also impacted the firms' decision to move away from an imitative technology strategy to a defensive one as the firm matured in its technological development.

National Institutions

Huawei's presence in more and more internationally mature markets exposes the firm to a wider set of domestic national institutional features and as such alter not only the challenges these pose to the firm but also the resources made available to it. This is reflected in the firms' change in technology strategy away from imitative towards a defensive one in order to comply with more stringent IPR regulations in Western matured target markets. At the same time, Huawei's progress in technological development prompted the firm to take greater effort in protecting their own technological capabilities from both domestic and international competitors through an adjusted technology strategy. The Chinese state still plays an influential role for the firms technological and wider economic development through its strong support of the firm, for example in its international expansion strategy by offering cheap lines of credit to Huawei customer in developing nations via their state-owned Chinese Development Bank (Harwit, 2009). However, it is worth noting that while this national state support helped Huawei in certain parts of their business it did hurt them in others, as many Western state customers of Huawei been cautious over the close relation between the privately owned firm and central government authorities in Beijing. In 2008, US security authorities opposed and ultimately blocked a sale of the US firm 3com to Huawei over security concerns that the Chinese firm could get sensitive access to the US telecommunications network that might be of interest to the national security. Huawei denies any of the allegations made against the firm and its close ties to the Chinese central government and over the past year had become increasingly vocal about what it considers to wide-ranging misinformation about the firm. In 2012, the US House of Representatives brought forward a report on Huawei that concluded in the recommendation to not allow the Chinese firms any acquisitions in the US over concerns technology or sensitive information could leak to Chinese state

authorities (Benoit, 2012). Most notably, Huawei released an open letter in February 2012 detailing the firm's relationships with governments in both China and around the world with the intention to rectify the misconception of its political ties and establish itself as an upright firm within the global ICT industry (Goldman, 2012). These rising external pressures forced Huawei further to adjust its technology strategy from an imitative one to a defensive one in order to support the firm's attempt of being perceived in the Western world as a reliable and reputable supplier of telecommunications equipment with no interest in utilising external technology for its own advancement.

Technology Strategy

The changed access to both international finance and labour markets through the firm's increased internationalisation further fostered the change from a less demanding to a more challenging technology strategy. While the commercial success of Huawei allows Huawei to be less dependent on external resources for financial funding, the access to the international financial markets allows the firm for a wider range of options to fund their technological development and makes them less dependent on solely domestic Chinese funding. Especially the access to international labour markets and as such to global talent and skill sets positively influenced Huawei's ability to transition from an imitative to a defensive technology strategy. In summary, the change in external resources for Huawei enabled the firm to successfully manage the technological transition from an imitative firm to an innovating firm and by doing so to overcome one of the major hurdles on the firm's path to technological ascent.

This concludes the empirical chapter of this study. The purpose of the empirical chapter is to descriptively present the raw data, guided by the heuristics set out in chapters 2, 3 and 4. From this, the following discussion and conclusion section will provide a more in depth interpretation and conclusion of what this data means with respect to the research question set.

6. Discussion

6.1 Purpose of Chapter

Based on Whitley's seminal work, this chapter will now draw together relevant theoretical frameworks with the empirical findings derived from the case studies to explore differing technological developments of domestic Chinese firms, and explore how these differences emerge from varying interactions between institutions, firm characteristics, and technology strategies.

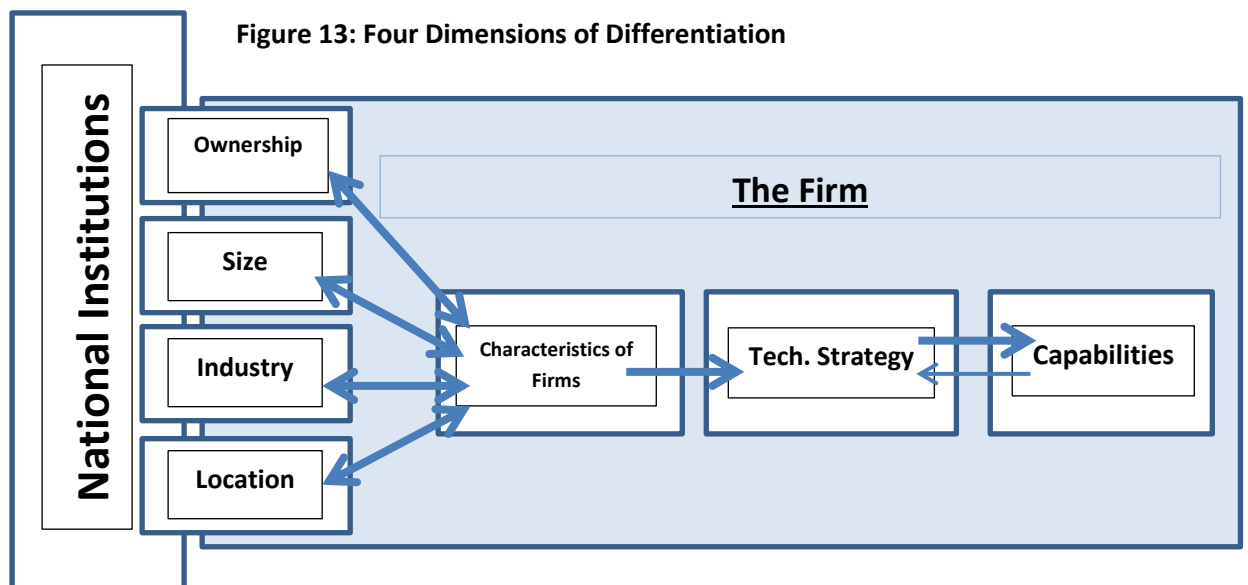
The case studies undertaken for this study strongly support the existence of a causal link between the features of China's national institutions and how firm characteristics develop. These firm characteristics then determine the specific technology development strategy that they are able to utilise.

The national institutions in this context exert considerably more control over access to vital resources that firms require, most notable state financing but also personal networks to facilitate supplier and client access, and access to foreign investment. Furthermore the state creates the overall economic context in which firms operate. In this way many of the firm characteristics emerge either directly and indirectly in response to the institutional environment. The firm characteristics, in combination with the wider economic context, then determine the feasibility of various technology development strategies that firms may wish to adopt. Firms will adopt and change their technology strategy in response to changes in both their firm characteristics and the national institutional context over the course of time. Further, it has been found that this technological development does not take place in a consistent linear development. As can be seen from both the case of Zhuzhou Times New Material and Huawei Technologies, technological development can be linked to key events in the firm's history.

The case studies have shown the close correlation between national institutions as external conditions and firm characteristics as internal conditions to technological success. This is consistent with the theoretical considerations of Whitley (1999) and Fainshmidt (2016).

However the empirical findings have also demonstrated that examining the interaction between these two factors is particularly difficult for the Chinese context because the interaction between firms and institutions varies. Certainly the data in this study suggests that there is more to the technological success of domestic firms in China than a simple analysis of linkages between national institutions, firm characteristics and technological development can fully capture.

The empirical work indicated that for a firm to become technologically successful there are internal and external conditions that have to be met. A more nuanced examination of the firm characteristics by examining the internal conditions is vital. Relatedly the external conditions also need more detailed analysis. In China these conditions differ along the four dimensions of (i) ownership, (ii) size, (iii) industry, (iv) and location (Figure 13). These four factors are relevant to Chinese domestic firms as the impact of the institutional environment in China is not universal but rather mediated by the above factors. This will be further elaborated in section 6.2 to follow.



These four dimensions offer a more comprehensive tool for understanding of a firm's probability to become technologically successful, and this is the framework that has been used for the analysis and discussion of the case studies.

The following sections will now utilise this framework to discuss technological development of domestic firms in China. Section 6.2 will look at the four dimensions and how they impact the interaction between national institutions and domestic developing firms in China. Section 6.3 will then analyse the implications of the four dimensions on the ideal path to technological ascent.

6.2 National Institutions and Domestic Developing Firms – Variations in Interaction

As discussed there are four dimensions that can be used to systematically analyse the interactions between national institutions and domestic developing firms in China. These four dimensions are: (i) ownership, (ii) size, (iii) industry, (iv) and location.

Firstly, size does matter in China, as anywhere else, and as such needs to be considered. In the established literature greater size is always associated with better access to resources and therefore larger firms are assumed to be able to cope better with uncertainty than smaller ones. China is arguably no different in this respect. Greater size means access to greater cash reserves and enables stronger cash flow. Furthermore, and arguably particularly important in the Chinese context, size conveys higher prestige and substantial influence which lessen their risk. For example in the case of Huawei, it was only when it had grown significantly in size during its second development phase and established itself as a major domestic player that it attracted central government recognition and support. This was then associated with access to state controlled funding that it was exempt from previously. Many Chinese firms could be considered ‘too big to fail’ and as such are supported by the state – either directly or indirectly. Perhaps more frequently under this political system than others, large firms are also utilised as vital tools by the central government in order to implement their political and economic plans, and exert control.

Secondly, the industry in which the respective firm is operating has a significant impact on its interaction with Chinese institutions. Industries can be clustered into two main classifications: strategic and non-strategic ones. Strategic industries, or pillar industries, in China are closely controlled by the central government and usually display high entry barriers for domestic POEs and foreign firms (Harwit, 2008; Nolan, 2012; Xiao et al, 2013). Limiting entry to SOE’s allows the government to retain

considerable more control over these economically or politically important industries in a centrally planned economy. However once firms gain access to a strategic industry they benefit from significant advantages; such as easy access to centrally controlled financing and other forms of economic support, as well as political support for operation and development activities. In contrast, non-strategic sectors in China are less subject to central control and operate more under open market principles, as it is understood in the Western sense. These sectors are perhaps understandably more open to POE's and foreign owned firms. In this case, state interference is substituted by competition and firms need to overcome obstacles such as limited access to finance, qualified labour, and technology. The case study firms in this research possess different ownership backgrounds and illustrate this variance in access in resources. Especially at early stages of development ownership plays a crucial role in access to key resources such as finance.

Another important aspect is China's geographic diversity needs to be reflected in the analysis by differentiating between higher developed coastal areas and more remote inland ones. The coastal areas form the economic powerhouse in China and as such firms, both domestic and international tend to concentrate their economic activities here. Not surprisingly, the coastal areas centralise significant amounts of crucial resources in regards to finance, qualified labour and technology. However, due to their concentration and economic importance these coastal regions are also subject to more stringent central government control and supervision. In contrast, when operating in more remote inland locations there firms evade these high levels of central government attention. This is replaced by the interests of regional and local governments operating out of the 'spotlight' of Beijing. Although objectively less powerful than central government, these political interest can still have a significant impact on the success of firms by granting (or not) state support and access to finance, markets, and technology. However, inland markets are usually less developed and less demanding than the ones in coastal regions. Both consumers as well as competitors tend to exert less technological pressure onto the firm. Geographically isolated from competitors, especially foreign competition, firms in these regions face less technological development pressure. This is particularly important for comparatively young Chinese domestic firms in early stages of their technological development as it

provides them with a relatively isolated market space in which to develop their technical capabilities and cash flow in a less competitive market environment.

From the empirical work, the firms were located in opposing types of geographical location. TMT was based in the landlocked and remote Zhuzhou – a location largely unrecognised outside of China – but of great importance to the Chinese railway industry. In comparison Huawei is based in Shenzhen, one of the earliest free-trade zones in China that has established itself as Asia's version of Silicon Valley.

Ownership is frequently used as a single level of analysis for Chinese domestic firms. However it is not detailed enough to comprehend the complex and fragmented reality of the Chinese national institutional context. There are linkages between (i) ownership, (ii) size, (iii) industry, (iv) and location. For example in the case of Huawei, once they had achieved greater size, they were able to access funding and attract the political support that compensated for the potential disadvantages of their ownership structure, namely being a POE's in a strategic industry.

Further, the individual national institutions differ in the level of impact they exert on the characteristics of a specific firm and its subsequent choices in technological strategy. The role of the state is particular of importance as it not only influences the firm but also other national institutions. So has the state for example, and this is particularly true in the case of China, a strong influence on the financial system. This has been discussed in detail in section 3.2.2 of this work. Other institutional features, such as the educational system, are much less of direct impact on the individual firm as they are more commonly shared amongst wider groups of firms. In summary, the state is the key national institution that defines, albeit mediated through the four dimensions, the differences between the domestic Chinese firms as its impact on the individual firms varies greatly. This results in the state creating institutional environments that varies based on the four dimensions for each individual Chinese domestic firm. This will be further discussed in more detail in the sections to follow for each of the four dimensions.

All of the four dimensions are directly related to the role of the state and its national institutions. This is closely reflected in each of the four dimensions having clear

implications on the firms' financial, organizational, and innovative capabilities. This will be discussed in further detail for each of the four dimensions in the below sections to follow.

6.2.1 Differentiation by Ownership: Implications on Financial, Organisational, and Innovative Capabilities

The below section will elaborate on the implications of different ownership types onto domestic Chinese firms and their impact on the set of capabilities available to the firm. The initial focus will turn towards the State owned enterprises and their characteristic set of features. At a later stage of this section the privately owned Chinese enterprises will be discussed. When we talk about SOE's in China, there is an important distinction between *majority state owned enterprise* (MaSo) and *minority state owned enterprises* (MiSo).

As a result of the open up and reform period (改革开放 – *gǎigé kāifàng*; 1978 until today), the behavioural pattern of SOEs has gradually changed. Competition between SOEs has traditionally been absent, whilst information and knowledge sharing was common across ostensibly competing SOE's (Cheung & Rau, 2010). However an influx of competition from overseas and growth of the domestic economy has provided a space in which even SOE's are not immune from competition for resources, state support and approval (Cull & Xu, 2003). As a result the overall goals within the MaSo's are divided into socio-political objectives and commercially motivated objectives. Both sets of objectives have to be met to ensure the career ambitions of the official managers are met, but often they are competing. Managers have to generate growth and modernisation to ensure the continuing success of the firm, whilst meeting the political agenda; which may form conflicting goals. The socio-political goal of majority state owned enterprises is rooted in the Maoist legacy of SOEs, whereby firms are used as a tool to maintain harmony within the society. This is done by providing work and income for a vast number of people and is part of the strategy to fight the crisis of legitimacy within the Chinese Communist Party (White, 1986; Zhong, 1996; Chen, 1997). However this may well be contrary to the labour requirements of specific organisations; which need to respond to their own cost and/efficiency requirements in determining labour levels.

Another consequence of the short-term approach concerns the ability of firms to build their initial technological capabilities. It is necessary to deploy considerable efforts and expenses over a long period of time in order to build initial technological capabilities (Kling, 2006; Lehto, 2011). Often these efforts and investments are characterised by low levels of visibility, particularly if an imitative technology strategy is pursued, as the generated results do not turn into immediate and quantifiable results. This calls for high levels of industrial expertise from parties involved in the financial as well as the corporate governance side of the firm (Liu & Tylecote, 2016). Shareholders and managers need to be deeply engaged in technology and production processes to invest the needed patient capital in appropriate places (Sirmon & Hitt, 2003). The impact an engaged managerial team can have on the leadership of a MaSo has can be seen in the case of TMT. Their heritage was rooted in a research entity and this has had a positive impact on the firm's management approach to technology and innovation. A further challenge to the imitative technology strategy is derived from the complex and diverse processes and product components involved, which requires high levels of commitment and inclusion of employees (Xiao et al., 2010). In the case of MaSo's these additional requirements conflict with the reality of corporate governance. As managerial levels are usually parachuted into the company through political channels and given clear targets in a set period of time (Harwit, 2008) they are much more likely to opt for a dependent strategy that will generate fast results in terms of technological catch up and commercial success (Liu & Tylecote, 2016). The short-term focus in strategy and lack of employee contribution prevents managers from building up the desired accumulation of knowledge within the labour force. And yet the organizational complexity of operations means that a focus on responsiveness is also impractical (Liu & Tylecote, 2016).

The on-going success of MaSo's is of crucial importance for the ruling elite in order to legitimatise their authority and to actively influence and govern the economic development of the Chinese national business economy to enshrine their power and control. Preferential treatment of MaSo's means they lack incentive to build up their own internal capabilities, as well as isolating them from the market forces which would force them to develop them, or fail.

In the *minority state owned enterprises* (MiSo) the firm characteristics differ significantly from those of the majority state owned ones (Nolan, 2012). The relationship of the MiSo with state institutions and their level of interference vary substantially according to the degree of participation of state shareholders in the firm's operation. The less closely the MiSo is supervised by state officials the more autonomy and/or neglect they experience, which can be either a blessing or a burden depending on the wider context of the firm. These variances and their impact upon technological capability will now be explored

For MiSo's, the management selection process is executed through the shareholders and not through state directives (as with MaSo's). Therefore the type of control implemented revolves around return on investment (ROI). With different shareholders forming the dominant representation of owners within a firm, ROI is chosen as the grounds based on which managers are held accountable and consequently shape their decision patterns in terms of firm strategy. This in turn affects the firm's corporate governance. In logical coherence with this method of accountability the dominant goals are either ROI or dependent on the degree of shareholder inclusion into the internal procedure of the firm are overall growth. The willingness to invest into low visibility technological learning and innovation is dependent on two key aspects: First, the levels of engagement and inclusion of shareholders and their understanding of technological opportunities within the sector. First, patient capital whereby the shareholders are comfortable with slow pay-off associated with such investments. Second, the degree of autonomy and time that is given to higher management to achieve those set targets. If managers are given leeway to pursue a strategy of catching up through building indigenous technological capabilities, shareholders do not necessarily need to be engaged into the firms' day-to-day procedures as long as they give managers enough discretion. Cai and Tylecote (2005) identified another advantage of MiSo governed firms; they allowed for managers and employees to hold stakes in the enterprise. In established Western theories, this financial interest increases their levels of inclusion in the firms' corporate governance and commits them to the firm's success.

From a financial point of view MiSo's are in a less favourable position than their majority-owned counterparts. The latter have significantly easier access to external funding due to their state affiliation in comparison with private-owned firms. Due to the higher levels of competition over external funding, the degree of business partner collaboration is relatively low within these types of firms as opposed to financially less constrained MaSo enterprises. However, MiSo firms are generally less affected by state intervention and can follow economic objectives more freely without being held back by political considerations (Letho, 2011; Nolan, 2012).

MiSo's are considered attractive employers and hence usually do not struggle to access qualified domestic labour depending on their geographical location (Cai & Tylecote, 2005). Since a MiSo usually does not offer the same levels of job security as a MaSo, skilled labour has to be incentivised with higher wages and therefore is of a higher cost to them. The degree of employee inclusion is dependent on the strategic focus chosen by the firm. A focus on innovation often creates a greater interdependence between the employee and the employer as the firm is more reliant on the employee's skill set to generate the internal capabilities needed.

As already mentioned, the chosen approach to the firm's technology strategy is rooted in its overall business strategy and the degree of shareholder inclusion, as the consequent pursuance of an innovation focus is contradicting with the dominant goal of ROI and in need of an educated shareholder with a long term horizon.

The third ownership structure is that of the *private owned enterprise* (POE). This firm type has been expanding in number since the opening and reform policy was established in China. Although their position relative to the SOE's is still considered inferior, their legitimacy and ability to compete in the Chinese economy have been improving over the last couple of decades. However POEs are still somewhat considered second-class players compared to SOEs by the central government. This is mostly reflected in the lack of preferential treatment that POEs are subject to in comparison to SOEs, most notably the access to markets, finance, and advanced technology.

In terms of management selection, the shareholder model allows direct owner control over the choice of management personnel. In China private owned enterprises are frequently owner led, and there is a certain convergence between shareholder and owner. They tend to either be the same person, or have close personal ties (Whitley, 1992). As a result of this, firms are often organised as patriarchal firms once they reached a certain level of maturity, while smaller ones are usually opportunistic or artisanal in nature (Whitley, 1999).

The case of Huawei is an example of this type of organisation. The firm is organised around its owner, particularly during early years of development where its technical capabilities were drawn primarily from his own knowledge and experience. From a corporate governance point of view POEs exhibit a wide range of different organisational structures, and as such are harder to typify. Only in combination with the remaining dimensions of size, sector and location can they be grouped in a meaningful way.

Broadly speaking, the dominant goal of the POE's firm is to generate wealth and increase family reputation. This, of course, is a generalization. As private owned firms within China grow and reach different levels of maturity, the overall goals may well evolve with the changing circumstances. However, despite this wealth orientation, it can be argued that entrepreneurs are willing to sacrifice short term profits and do invest into long-term future opportunities (Liu & Tylecote, 2016). This particular set of characteristics influences the likeliness for certain capabilities to be fostered to emerge within the firm. The degree of employee contribution is often rather low, as the strong decisional dominance of the owner leaves little room for co-determination or integration of employees into the process of strategic decision-making. Within the field of business partner constraints, the lack of reliance in formal institutions causes the level of trust between different economic actors to be low and therefore keeping the degree of business partner constraints minimal as well. This in turn, has a negative effect on the possibilities for learning through engaged and experienced stakeholders.

However, a lack of reliance in formal institutions – especially in China – can be substituted by close personal relations forming trusted relationships between higher management and stakeholders in the firm. Huawei exemplifies this trend. As a POE, it

has been accused of having exceptionally close links between the founder and lead manager, Ren Zhengfei, and the state government as a result of his previous military employment. Although no isolated and clear effect of this relationship on Huawei's performance or development has been found in the case study, given the tacit nature of these types of relationships it is unlikely to be clearly documented. However it is likely that this has conferred at least some goodwill towards Huawei as a result of these mutual and personal relationships.

Privately owned firms often face severe capital constraints, which are worsened by an underdeveloped and state controlled financial system and limited availability of externally funded capital (Batjargal & Liu, 2004; Wu & Yue, 2009). Although the overall situation of the Chinese financial market is improving, the conditions for external finance available to POEs are still considerably less favourable than the ones accessible to SOEs leaving them at a clear disadvantage. This often leaves privately owned firms in a precarious financial situation, limiting the possibility and willingness to bind capital into future investments that do not generate immediate profits. This limits the feasibility for these firms to pursue an innovation-focused strategy (Liu & Tylecote, 2016). A focus on responsiveness is much more plausible to evolve as these firms due to their low degree of constraints are rather flexible towards market changes and can adjust to these within short term.

The financial market is not the only area in which POEs suffer a significant disadvantage in comparison to SOEs. In the public perception, POEs are considered less attractive as employers compared to SOEs. The common belief in China still is that the state ownership is a guarantor for a secure work place and ensures long term stable employment. In addition to this, most SOEs offer additional non-monetary benefits such as housing allowance, health insurance, food discounts, and child care (Hughes, 2002). In order for POEs to compete and recruit to attract and retain skilled workers they will need to pay higher wages than their SOEs counterparts. While foreign firms can, at least partially, offset this disadvantage in employment security through offering a prestigious name on potential candidate's curriculum vitae, domestic POEs are left with only the monetary aspect as lever to recruit talent. A problem which, if other countries are any indication, will only worsen as China's economy continues to

restructure fostering fears of economic instability amongst employees. Job security is an increasing concern for many candidates than in previous, arguably more prosperous, years.

In China POE's that develop in line with the states broad economic policy objectives, yet away from the direct influence of central government, have proven to be in an advantageous position compared to SOE's. This was observed in the Huawei case, with the firm turning to the remote areas at an early stage of development giving the firm access to a large market protected from direct competition (Harwit, 2008). While full government support comes with preferential treatment on such matters as access to capital, market, and labour; these firms do often need to comply with a wider range of socio-political interest such as provision of employment, support of party interest, and maintaining a harmonious society (Nolan, 2012). This limits their scope to manage effectively solely in the performance interests of the firm, and constrains their decision-making ability compared to a POE. For example, TMT as a smaller SOE is less affected and yet they are an part of an important employer in the city and region and as such are restricted in their decision in regards to firing employees.

Further, the close linkage to political authorities strongly influences the corporate governance structure which negatively influences the development of a sustainable technological capability strategy (Xiao et al, 2013). Full government support for many of the Chinese firms has proven to stifle innovation and opportunity seeking through limited market mechanism and high levels of political interference. Regardless on the level of support by the central government it is impossible for any Chinese firm to pursue a growth strategy in an "unwanted" direction against the political interests of the central government.

At a later stage of development a certain degree of government support can be beneficial to the POE's firm development, especially to pursue an internationalisation strategy as can be seen in the case of Huawei. At this stage most firms have matured to a degree that they can sufficiently argue their interests against central government political interference by utilising government incentives to their benefit. However this can only be done if the development is in line with the economic policy objectives of the central government. For example, if it is of high priority for Chinese policy makers

to foster the development of internationally competitive Chinese firms, then firms pursuing an internationalisation strategy could significantly benefit from state support. This support comes in the form of cheap soft budget loans, export incentives, and credit facilities for prospective international customers.

6.2.2 Differentiation by Size: Implications on Financial, Organisational, and Innovative Capabilities

Size is arguably the factor influencing the development of firm's capabilities that is most independent from the national context. Generally it is assumed that larger firms will have greater resources and will be better equipped to overcome unfavourable circumstances. This is no different in China.

Yet, the national Chinese institutions do deal with the matter of size in a unique manner, which has a direct impact on the above-mentioned aspects of firm governance. Therefore it is useful to discern between those of different sizes in conjunction with ownership structures in the Chinese context. They are (i) small/medium SOEs, (ii) large SOEs, (iii) small/medium POEs, and (iv) large POEs.

Small/medium-sized SOE is a diverse group of firms in terms of corporate governance, finance, and labour relations. Smaller SOEs often experience a more difficult time in the battle for resource against their bigger counterparts, which goes hand in hand with certain levels of neglect by central government bodies depending on the firm's importance. Many of the successful smaller SOEs end up integrated into larger SOEs, and have to establish themselves within those wider organisations. Less profitable ones either get privatised or left alone to the market (Nolan, 2012). However being an SOE they still enjoy preferential treatment over non-state firms in regards to access to capital, labour market, and technology.

This diverse picture continues in terms of corporate governance as well. Usually state-owned firms are characterised by a lack of engagement and expertise among controlling officials and limited inclusion of employees and other stakeholders, which is associated with a less favourable environment for learning and capability building (Liu & Tylecote, 2016). Under the full support and attention of central government bodies, this is frequently the case for small/medium SOEs. They share the advantages and disadvantages of larger SOEs and the resulting impact on corporate governance. It

is really only the disregarded small SOEs that have the potential for a different approach on corporate governance and capability building. As in the case for TMT, the firm benefited greatly from the financial resources of its parent SOE and yet, operating in a niche market, was afforded the scope to operate without major interference by authorities. Combined with the well-educated and engaged managerial team this greatly contributed to TMT's technological success. Less support from central government bodies provides more leeway for small SOEs to operate freely, and for managers to build a leadership of engagement and inclusion. Less direct control would also result in lower pressure on low-visibility investments into learning, and the associated slow pay offs. As managers of a these small SOEs, they are not faced with high expectations by their controlling officials. Managerial discretion becomes of crucial importance to corporate governance of small/medium-sized SOEs (Liu & Tylecote, 2016). The status of an SOE, regardless of how small or big, will still result in easy access to finance as the state as a guarantor will open access to financial resources.

Large-sized SOEs are often the key players in their respective industry and hence enjoy full government support and preferential treatment, including: access to qualified labour, admittance to domestic and international markets, access to technology, and wide availability of cheap financial resources. Such strong levels of support do place the firm's performance into the spotlight and put pressure onto managers to generate results. This pressure is reflected in the corporate governance structures of large SOEs. Liu & Tylecote (2016) identified two main shortcomings in the governance mechanism of SOEs in regards to technological capability building. Firstly, the arm's length relation between most SOEs and their supervising officials causes low levels of engagement. Most state officials lack the industry expertise in order to fully understand the managerial decisions made. Secondly, the focus of managerial relationship building lies with senior state officials, leaving only very limited time to invest in relationship building and inclusion of employees and other stakeholders. In summary, large SOEs can be expected to display low levels of engagement and inclusion in corporate governance resulting in limited willingness to invest efforts into any low-visibility developments. Further, the high levels of central government support in turn can result into firms being strongly affected by policy constraints. These policy constraints

depending on their origin can cause for political interests to outweigh economic considerations within large-sized SOEs.

However, large SOEs usually enjoy very easy access to capital at highly discounted rates, which allows them to face challenges with strong financial backing (Thun, 2006). This privileged position permits SOEs to generate a strong foothold in many industries, as they have the needed financial resources to acquire advanced Western technologies regardless of costs. The result of such an oversupply of financial resources is a fostering of inefficiency. In certain circumstances common governance mechanisms are overruled by state intervention. However, due to their size, economic and social importance many large-sized SOE operate under the security of being “too big to fail” which allows them to continuously count on strong central government support.

Size for private firms can also be seen as an indicator and/or guarantor of security, as usually larger size comes with stronger regional or central government support in the competition for resources. *Small/medium-sized POEs* can be considered the least advantageous group of firms in China. Their small size and lack of any regional or government support mean that they lack access to capital, strategic markets, means of government protection, and qualified labour giving them a very disadvantaged starting point. These kinds of firms are usually opportunistic in nature, and follow an opportunity-seeking strategic approach. Huawei was no different in its initial phase of development. However, they benefited from an engaged owner with a clear strategic intent for the firm. More typically these firms lack a clear longer-term strategic approach and/or are too immature to have developed robust corporate governance structures, technological capabilities, and modus operandi with national and regional institutions.

The last category is *large-sized POEs*. This type of Chinese firm does pose a contradiction. Based on the experience of small/medium POEs, these firms should, in theory, not be very likely to succeed. However they represent successful opportunism, in that they have grown into larger firms. China’s size and the lack of institutional implementation allow firms to develop under the radar, and to grow protected from strong national and international competition and central governance interference. Often these firms secure local or regional government backing at earlier stages of their

development to provide them with certain levels of state support and protection (Harwit, 2008; Letho, 2011; Nolan, 2012) but only when there are personal connections or where they align with those government actors' objectives. The role of local and regional governments is not to be underestimated in China and will be discussed in further detail in section 6.3.

Once a small POE has undergone the rite of passage, developing under the radar until they have achieved a size to garner some state protection, they will become subject to central government acknowledgement. This acknowledgment often comes with preferential treatment, although not to the same extent as large-sized SOEs, but still to a considerable degree. Yet, such preferential treatment comes at the price of political interference (Liu & Tylecote, 2016). In respect to corporate governance structures large-sized POEs can vary considerably as they combine a wide arrange of development paths and leadership styles. However, for a small POE to survive in the highly opportunistic market environment it is faced at early stages of development it is dependent on an engaged leadership and supporting stakeholders to survive and to grow. Employees can be expected to have a close relationship to the management as large-sized POEs often start out as a patriarchal firm. This approach on corporate governance is further supported by the lack of access to capital and exposure to advanced Western technology which denies large POEs at early stages of their development to fully rely on external sources for technology. As a result, they will need to invest in technological learning and catching up which is associated with low-visibility and slow pay offs, yet higher levels of capability building. An owner-run POE is more likely to pursue this type of strategic approach than a large SOE run by a salaried manager with political ambitions.

In summary, it can be stipulated that size, regardless of ownership type, comes with higher levels of security and liquidity. This is of universal truth and not restricted to the Chinese context. The cases seen in China certainly do not behave differently from this assumption. Yet the associated development path from a small to a large-sized firm of different ownership types does differ significantly. This difference is an aspect unique to the Chinese context. The lack of government support and protection in early stages of the development forces POEs to developed under the radar until they have reached

a certain size and importance to gain government acceptance. This problem is further reinforced by the lack of access to both affordable capital and trained labour. These shortcomings forces Chinese POEs to develop different governance mechanism than the ones of SOEs.

6.2.3 Differentiation by Industry: Implications on Financial, Organisational, and Innovative Capabilities

The key aspect of *strategic industries* in China is the higher level of state support and control executed over those particular sectors. This strong state influence onto a national market economy comes with associated advantages and disadvantages. Generally speaking, the more important a specific industry is from a political or economic point of view, the more likely that SOE's will dominate whilst POE's will be excluded. SOE's enjoy closer ties to the central government in order to allow the state to implement its overarching strategy within the sector. High market entry barriers will keep non-state owned firms struggling to succeed in such strict protected industries. Naturally this results in few POE's in these industries; instead they tend to disperse into less strictly monitored and regulated market segments where they are afforded a more level playing field. While foreign POEs occasionally can gain access via joint-ventures under the premise of technology transfer, domestic POEs – unless they demonstrate an asset that justifies their importance, such as advanced technology or valuable international connections – often face closed doors to these prosperous sectors, allowing SOEs to operate in a de facto monopoly/oligopoly market within the industry.

These high levels of state influence are reflected in the governance structures and technology strategies pursued by both SOE's, and the few POE's firms, active in these industries. As explored previously, often with this level of state influence political considerations and state targets outweigh firm-level economic concerns. Operating in a pillar industry affects the willingness and engagement for learning and technological catch up. While the central government sought to address the lack of innovation, and prioritised technology transfer and catch up as an area for development within SOE's, this has not appeared to foster a higher rate of indigenous technology absorption. The high importance of political targets for technology transfer, combined with limited levels of expertise by those controlling firm have resulted in managers typically

choosing a dependent technology strategy. Facilitated through joint ventures with foreign firms, this strategy allows relatively quick generation of technological advanced products (Liu & Tylecote, 2016). This worked particularly well for China as it used its market size and potential as leverage to encourage foreign firm to enter into joint ventures, and yet the degree of technology transfer remained low. Further, in regards to corporate governance managerial efforts revolve more around building the required relations with government institutions to rally support and maintain favour with state officials than to build relations with stakeholders and employers to increase their level of involvement. With most firms operating in strategic industries as SOEs, the impact on corporate governance and labour relations are mostly in line with those earlier discussed under ownership in section 6.2.1. They are merely reflecting the fact that strategic sectors are more accommodating to SOEs, while non-strategic ones are more favourable to POEs resulting in the limitations of labour relations to be distributed accordingly throughout the two types of industries.

However in terms of finance, state ownership is beneficial to gain access to capital for firms in China and access is even more likely if the respective firm is operating in a strategic industry. These industries are usually subject to considerable stimulus packages that allow firms to pursue their goals with few, if any, financial restrictions. The more important the firm is to the current economic plan, the more the abundant financial resources available to them. However such financial abundance carries inherent dangers. Firstly reliance on a single finance avenue leaves them subject to a risk - the governments policies could change and a firms anticipated financing could be re-routed to other industries. For example the ship building industry was regarded as an integral, strategic industry in the early years of Chinese economic development. However as its importance declined in the face of wider socio-economic changes it's usually funding was halted, leaving it struggling with overcapacity and lack of technological capabilities years later (Nolan, 2012). Secondly, falling out of favour with the state, or the impact of soured personal networks could directly and quickly impact the firms' financial situation.

Non-strategic industry sectors do not enjoy the abundance of state financed resources and wider government support that strategic ones are provided with, but these

shortcomings do come with its advantages. Most notable is the lower level of regulation present in non-strategic industries, which allows firms to operate in more liberal environment ruled by market principles. As such, non-strategic industries are more open to the entry of both POEs and SOEs without any additional entry barriers. POEs are more able to populate these industries and often they outperform their SOE counterparts. That is not to say that they compete on an equal basis, SOEs still enjoy preferential treatment over POEs but they are more competitively present in non-strategic sectors.

It is difficult to directly isolate the effect of sector onto the corporate governance structure of a firms, as they are attributed in the wider field of the four dimensions discussed. In general, POEs and the type of corporate governance structures that they employ are better suited to the liberal market sectors than SOE firms with their governance structures (Liu & Tylecote, 2016). Many of the competitive shortcomings in SOE corporate governance structures can be compensated by sheer size and the high levels of preferential treatment enjoyed, resulting in successful performance. However, POEs and their higher levels of engagement and deeper technological understanding are arguably in a better position to anticipate customer's needs. They also possess more freedom in governance and control to adjust production to meet these in a timely way, allowing them scope to outperform their SOE counterparts. Although POEs still face disadvantages from a financial perspective even if they are operating within a non-strategic sector, non-strategic sectors allow POEs to generate cash flow to fund future developments and build up technological capabilities.

In summary, the importance assigned to strategic industries by central government mean that they are often out of reach for POEs and their associated forms of corporate governance, labour relations, and financial set up. While in turn the less regulated and more liberal non-strategic sectors may provide more scope for POE to capitalise on their relative freedom and the flexibility of their governance structures to compensate for their resourcing disadvantages and develop greater innovative capabilities than SOE's.

6.2.4 Differentiation by Location: Implications on Financial, Organisational, and Innovative Capabilities

Chinese economic development has been impressive; however it has not been one of equal geographical distribution. Most economic activities are focused along the coastal regions and the designated 'special economic zones': in particular Shenzhen, Shanghai, and North Tianjin. There is a considerable discrepancy in economic development between tier one and tier two or three cities, which is reflected in the level of attention and support those city enjoy from central government.

The advantages of *costal locations* for Chinese firms are numerous, but the key benefits are: better overall infrastructure, access to foreign firms, cluster effects through set up of supplier industries, and easier access to qualified labour (Cai & Wang, 2002; Zheng, 2005). As previously discussed, whether this truly represents an advantage or disadvantage is dependent on the type of firm however, SOEs will generally benefit more from such closeness to the central government than POEs. It can be argued that such close supervision and interference of central institutions can be harmful to the development of smaller POEs intending to substantially grow in key industries. Smaller POEs will generally struggle in coastal areas, as they will lack the capabilities to compete against established domestic and advanced Western firms. Although competition, the close geographical presence of Western firms can provide an opportunity for learning as domestic firms can benefit from existing supplier networks and access to qualified labour. For this to have a positive effect on the development of technological capabilities however, the respective corporate governance mechanisms need to be in place to encourage such learning.

From a financial perspective, in coastal areas funding is more widely provided but more closely monitored through government institutions. This can result in preferential treatment for certain types of firms over others. Further, the labour market in the developed coastal areas allows easier access to a large pool of qualified labour, not only domestic labour but due to the proximity to foreign firms they can draw on a large pool of foreign labour (Cai & Wang, 2002). However the ability to utilise these labour benefits is not equally open to all types of firms. Smaller SOEs and POEs in particular will struggle to compete in the lower end of product markets, as they are faced with the higher cost structures of coastal regions while simultaneously

not being of a great enough size or importance to effectively reap the benefits of closer central government support and access to technology.

Inland locations on the other hand are usually associated with lower end markets, both from a technology and profit point of view, and to be of inferior nature in comparison to the coastal ones and they also suffer an absence of core infrastructure development which can increase the costs of business. Yet, the closeness to remote markets can have its advantages. Firstly it allows firms to develop under the radar away from central government supervision and interference (Zheng, 2005), which is particularly important for those attempting to enter strategic markets where the level of control is high. This doesn't mean that firms in this location are free of government control entirely. Instead of central government interference, local and regional governments become more important actors for them. Close relationships with local and regional government can provide access to finance, and can help compensate for the other disadvantages the location is associated with. Secondly, the lower levels of demand within the inland regional market and its low cost structures make it easier, especially for new firms, to establish themselves. Furthermore the size of China's inland regions provides considerable scope to generate revenue to fund further endeavours and development of greater technological capabilities. This approach is a fairly common route for POEs in China, to circumvent the initial problems of lack of state support, access to funding and finding find a niche to grow under the radar. The absence of foreign firms in the more remote inland markets is particularly advantageous as it leaves a void for relatively underdeveloped domestic firms to exploit. The case of Huawei demonstrates the success of this type of locational strategy.

However, the remoteness of most inland locations does come with its disadvantages, too. Due to the lack of advanced domestic or foreign firms, access to technology and supply clusters is usually limited. This is illustrated in the case of TMT, and how in this particular case the firm was able to overcome the geographical disadvantages. A remote location means there is fewer spill over effects that the company can benefit from - such as hiring qualified labour from competitors or suppliers, and a limited international labour pool. All these aspects combine to create a broadly negative impact on the scope of learning available to domestic firms. Further, with the lack of

central government attention and interference, less foreign technology will become available especially for SOEs located in those locations.

In summary, both locations have its merits and depending on the developmental stage and type of firm it can be of advantage or disadvantage to be located in either a coastal or inland location. Generally speaking, SOEs are less affected by their location as POEs are due to the fact that they will be subject to central support either way even if the extent will varies. POEs are usually disadvantaged by the central government, especially in early stages of the development, for them it can be of benefit to retract to an inland location and substitute central government support through local or regional backing.

Differentiation and Technological Ascent

As has been explored, the four levels of differentiation by ownership, size, sector, and industry lead to varying starting points of Chinese firms in the path to technological ascent. It has been shown that that different level of access to external and internal resources are determined by these four factors, and they, in conjunction with each other, will impact the firm's choices regarding technological development. Furthermore they also impact the ability of a firm to position it to successfully implement the chosen technology strategies. However it is important to note that a firms positioning across these four factors is fluid; and the linkages between them evolve along with the individual firm's development. A firm's ability to exploit the various advantages and disadvantages associated with each differentiation factor, and adopt a successful technological development strategy, vary according to their whole current context.

The following section will look in more detail at the Chinese ideal path to technological ascent. Starting with an overview and analysis of the different types of firms in China based on the above used four levels of differentiation these firms will be linked to their most likely choice in technology strategy based upon their anticipated needs and available external and internal resources for successful implementation. Finally these considerations will be placed onto a wider timeline of development, to avoid examination of these aspects in isolation and at a static event at one point in time.

6.3 The Chinese Ideal Path to Technological Ascent

The following section will focus on the implications of the four dimensions on the ideal Chinese path for technological ascent. As discussed in the previous chapters, the key characteristics of firms are strongly influenced by the national institutional features which in turn impact on the viable technology strategies the developing firm can adopt. Therefore it is important to consider the pattern for the ideal path to technological ascent within the relevant national setting.

The section will start by looking at Chinese firms based on the how advantages their access to key resources are and in which way this impacts the ideal path to technological ascent. In a second step these different types of firms will be further linked to technology strategies and their applicability within the national Chinese context. As for structure this subsection will closely follow section 2.6, The Ideal Path for Technological Ascent of Developing Firms, in the general literature review whilst placing particular emphasis on examination of the linkages between the characteristics of the Chinese developing firm, the national institutions and the most viable technology strategy.

In line with the logics regarding the four dimensions and their resulting implications for corporate governance, finance, and labour relations, it is clear that the development of a matrix of 24 types of domestic Chinese firms is necessary. Within China not all types of firms are treated equally, as has been established in the above discourse, instead there is a clear gradient between advantaged and disadvantaged firms based on their location within the four dimensions of analysis.

In this particular context firms are understood as having differing levels of access to state controlled resources; but preferential treatment does not necessary translate to successful technological development. Developing Chinese domestic firms depend on their position in relation to the four differentiation dimensions to designate them as either advantaged or disadvantaged in terms of their interactions with the national institutional environment. Advantaged firms are being understood as the type of firm that is granted preferential treatment and access to resources through the Chinese institutions while disadvantaged firms are the ones being denied or offered less preferential access to these.

A firm enjoying access to substantial resources through state support would be more assumed to be more likely to be economically successful, but associated governance and innovation restraints may be reflected in the levels of technological capabilities. Many of the state-owned Chinese car manufacturers are very successful in China with their joint ventures and yet their story of technological development can hardly be called a success. This consideration is backed by the Fortune Global 500 list ranking the top 500 corporations worldwide as measured by revenue, which in 2015 stated 98 Chinese domestic firms of which only 22 firms been privately owned (Forbes, 2015). Again, it can be assumed that private owned firms will be less likely to have access to the state controlled resources as compared to their state owned counter parts. Not surprisingly the top twelve companies featured in the list are all state owned enterprises, with the government as their largest shareholder; Chinese SOEs do enjoy massive state support fostering growth and insulate them from competition (Walter & Howie, 2012). China's former state assets regulator, Li Rongrong, has used the term "natural monopoly" to describe the dominance of China's state owned enterprises (Hong, 2012). This dominance is largely considered to be associated with higher levels of costs and low levels of efficiency by firms according to economists and scholars. As far as the choice in technology strategies are concerned the initial assumption would be that a major advantaged firm should be the one possessing all the needed resources and skills to pursuit a less dependent technology strategy. However, in the Chinese context 'advantage' is reflected in access to state controlled resources and not always reflected in the level of technological success. Technology strategies are, of course, rooted in access to respective resources but this is not a simple relationship. Firms need the appropriate corporate governance structures to facilitate a willingness to learn and innovate. In this way it is perhaps unsurprising that most of the firms who form the focus of Western discussion for their technological success are POE's rather than SOE's, for example: Alibaba, Huawei, Baidu, and Xiaomi (Jones, 2015).

Based on the considerations of the four dimensions, Chinese domestic firms can be placed on a scale from most advantageous (large coastal based majority state-owned enterprise operating in strategic industry) to least advantageous firm (small sized inland based privately owned enterprise operating in non-strategic industry). These

two exemplify the opposing extremes of this scale, leaving all different shades of grey in between for domestic Chinese firms to fall into (Table 27).

Table 27: Chinese domestic firm matrix overview

	Type of Domestic Chinese Firm
Major Advantage	Large sized strategic coastal Majority SOEs
Advantage	Large sized strategic coastal/inland Minority SOEs and POEs
Approximate Parity	Large sized non-strategic coastal/inland Minority SOEs and POEs
Disadvantage	Small/Medium sized non-strategic coastal/inland Minority SOEs and POEs
Major Disadvantage	Small/Medium sized non-strategic coastal/inland POEs

This scale is necessarily a simplification of the whole context situation, and as such it is not fully able to grasp the complexity in regional difference between coastal and inland locations. Yet due to the existence of broad trends in firm type, it is still a useful classification tool to understand differing access to resources.

In light of this classification, there are five key types of domestic Chinese firms: (i) Major Advantaged Firm, (ii) Advantaged Firm, (iii) Approximate Parity Firm, (iv) Disadvantaged Firm, and lastly (v) Major Disadvantaged Firm (Table 27).

The major advantaged firm as a particular type of SOE enjoys the full weight preferential treatment from the institutional actors, whilst also benefitting from wider favourable economic trends. Following the logic of the four dimensions underlying the typology, due to its large size of operations this type of firm is both more economically as well as politically important, hence enjoys greater preferential treatment from the state and state-owned banks in access to funding. Size is the most generic factor to be utilised in the typology. It can be asserted that the bigger a firm, the more likely that they have larger revenues and financial reserves to cope with adverse external circumstances. In the case of China, this phenomenon is accompanied by generally higher levels of political interference for political and economic gain. So for this type of

large, coastal SOE even if their own reserves are not sufficient to ensure survival, the state will protect the firm within the market wherever possible. Furthermore its coastal region location ensures that type of firm is well positioned to reap the benefits of the advanced infrastructure, better linkage to the central institutions, and access to frontier technology through Western firms. This list of advantages can further be extended to include access to educate and skilled domestic and foreign labour, and availability of both domestic and foreign supplier networks. These supporting economic factors further increase the advantage the firm enjoys over its fellow domestic Chinese counterparts. By operating in a strategic industry its advantage is further increased. These markets are subject to close governmental supervision and access restrictions for both domestic and foreign firms, so the level of protection and support for incumbent SOE's is even more substantial, effectively insulating it from all external competition. The final "golden ticket" is the ownership status of being a majority SOE and as such being at the focal point of state attention. The majority state ownership can be seen as a guarantor for preferential access to markets, technology, and most of all financial resources.

The sum of this advantageous positioning is easy access to resources and preferential institutional treatment, which in turn affect the corporate governance structures of such a firm. Managers in a *Major Advantage Firm* are more than likely going to be focused on achieving fast technological results. As state officials on a temporary, and usually rotational, contract they are subject to the supervision of disengaged non-expert state entities. Access to substantial resources, including costly foreign technology, and close state monitoring also create substantial expectations of performance. To achieve the rapid technological development required to meet these expectations *Major Advantaged Firms* will most likely chose a dependent technology strategy.

The four remaining firm types follow this underlying logical basis (Table 28).

Table 28: Chinese domestic firm matrix and choices in technology strategy

Firm Type	Type of Domestic Chinese Firm	Technology Strategy
Major Advantage	Large sized strategic coastal Majority SOEs	Dependent Technology Strategy
Advantage	Large sized strategic coastal/inland Minority SOEs and POEs	International-Imitative Strategy
Approximate Parity	Large sized non-strategic coastal/inland Minority SOEs and POEs	Domestic-Imitative Strategy
Disadvantage	Small/Medium sized non-strategic coastal/inland Minority SOEs and POEs	Domestic-Imitative/No Technology Strategy
Major Disadvantage	Small/Medium sized non-strategic coastal/inland POEs	No Technology Strategy

The *Advantage* Firm benefits from its large operational size, its beneficial coastal location, access to domestic and international labour forces, and last but not least access to the established network of suppliers. Further, operating in a strategic industry ensures for both MiSo's and POEs to enjoy limited scope of competition, as strategic industries and the respective firms operating in it are state protected and supported. However, the limited levels of direct state supervision of managerial decisions result in a different structure of corporate governance, allowing for a higher level of engagement by all stakeholders and hence a possess a different perception of technology and learning. As a result the Advantage Firm is less likely to follow a dependent strategy, but to choose a more ambitious international-imitative one to reflect this different corporate governance structure. With their higher affinity to technology they will most likely aim to compete based on quality rather than price, at least at later stages within their development. Often the added quality aspect is created by adapting and tailoring already developed products to meet local needs.

The *Approximate Parity Firm* is operating in a similar overall economic environment than the Advantaged Firm. However, the Approximate Parity Firm is not operating in a strictly regulated strategic industry, but a more unregulated market driven sector.

Hence it is faced with significantly more competition from both domestic and foreign firms. As a result this type of firm is faced with more external competitive pressure affecting its corporate governance structures. This is further amplified by the lack of preferential institutional treatment, creating a more hostile economic environment for the Approximate Parity Firm to face. Firms dealing with higher external pressures and a lack of preferential access to resources – in combination with the corporate governance set up – results in them selecting to follow a less ambitious domestic-imitative technology strategy. Due to the higher levels of competition, Approximate Parity Firms tend to choose price-based competition models rather than ones based on quality.

Disadvantaged Firms are operating at the lower end of the ‘preferential’ treatment of domestic Chinese firms. They are small in size and lack institutional support, and as such are often faced with severe disadvantages in accessing financial resources. This leads to difficulties in retaining qualified labour and obtaining technology for initial stages of development. This is also reflected in varied levels of corporate governance. Hence the approach of these firms technology strategy can range from a domestic-imitative one to one with no clear strategic approach at all. The exact strategy depends on the levels of opportunism present in the firm. In either case, Disadvantaged Firms usually pursue a competition model based on price rather than quality, due to the combination of all of these limitations.

The Major Disadvantaged Firm represents the final ideal type of firm, which often is patriarchal type of firm with no clear technology strategy to be identified. Of a smaller size, these types of firms lack access to most of the key resources such as technology, markets, and most importantly financing. Major Disadvantaged Firms are largely opportunistic, driven by daily survival through production of products of low technological intensity. Due to their small size only internally generated and usually limited streams of revenue can be used to fund any future endeavours. The structure of their corporate governance reflects this daily struggle, and low margins leaves only limited room for investment to push the firm into higher technological spheres. As far as the competition model is concerned, Major Disadvantaged Firms usually compete

on price instead of quality; although again this needs to be put into the wider context and there has to be an appreciation of variations for artisanal firms.

In summary, each of the five types of Chinese developing firm can be associated with the most feasible technology strategy for them, based on their associated firm characteristics. This allows for a more robust understanding of the probability for certain Chinese domestic firms to become technologically successful than previous analysis have provided.

7. Conclusion

This study set out to investigate the linkages between the development of technological capabilities within Chinese domestic firms and the national institutional context in which they operate. This research utilised two case studies of Chinese developing firms that managed to succeed in developing superior organisational capabilities. Specifically this research project examined the ideal path to technological ascent and mapped existing Chinese firm's progress against this path, before finally analysing what contextual factors contributed.

In order to conclude this study each of the research questions will now be revisited and the findings summarised.

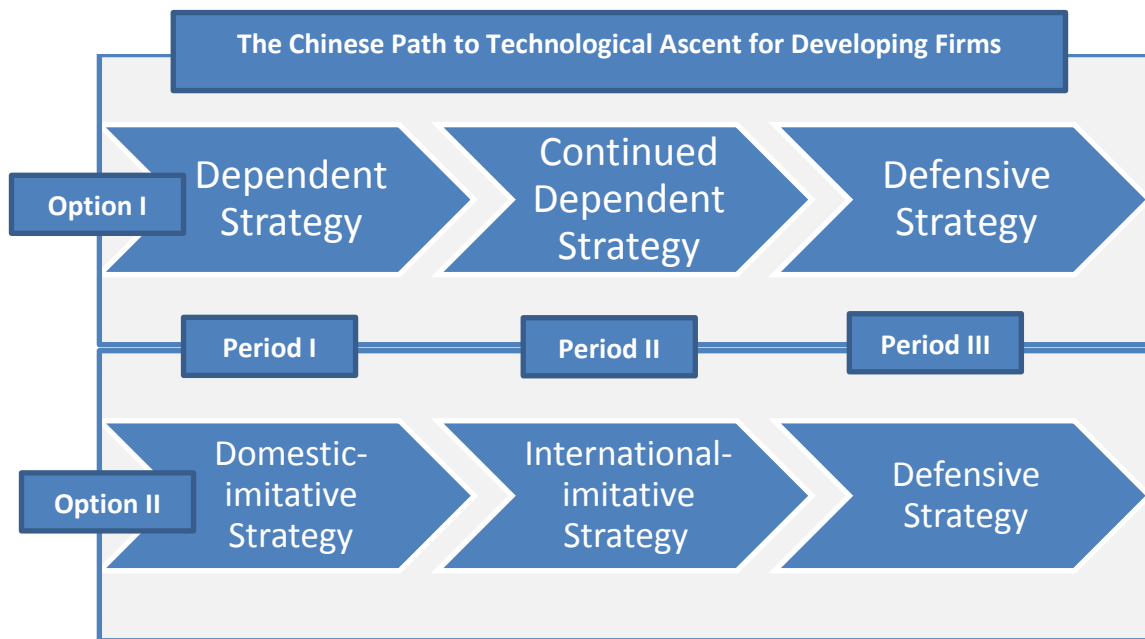
The first research question was:

Research Question 1: What is the optimal path to superior organisational capabilities for Chinese domestic firms, and how have national Institutions shaped the firms path to technological ascent so far?

In existing research, national institutions and technological ascent have been analysed in a disconnected manner. Both Whitley's pivotal work (1999) on institutional frameworks and Freeman's work (1992) on technology strategies informed the theoretical basis for understanding technological capabilities and national institutions in China. Yet, both fail to sufficiently explore how national institutions and technical ascent are directly linked. In exploring these links, China provides a unique case for the examination of the impact of national institutions. As a state controlled and planned economy, it is impossible to isolate a firm's development from the impact of the state. From the systematic review of existing literature, and two in depth case studies of Chinese domestic firms, an ideal path to technological development for developing firms in China has been created from this thesis.

In terms of the optimal path to technological ascent, it has been explored in detail that the specific strategy a company could adopt would be linked to their specific company context. However from the case studies it can be suggested that there are two main strategies that Chinese domestic firms can adopt:

- Option I: The dependent to defensive strategy
- Option II: The imitative to defensive strategy



Option I is more suitable to established firms with secure access to finance and markets, whilst Option II is more fitting for developing firms as they usually lack both of the above.

In terms of Option I, firms starting on a dependent technology strategy tend to rely overly on the firm providing the technology as an external source of technological capabilities. They become reliant on external input rather than the acquired technology being unbundled and integrated in the firm's capabilities; and as such developing firms are less likely to achieve technological ascent via this strategy. The Chinese automotive industry has been mentioned as a prime example within this work. The leading Chinese firms in the industry in terms of volume all built their technological skill set on a dependent technology strategy and still do so today. They have, yet, failed to move away from a dependent and towards a defensive technology strategy.

Option II, starting with a domestic-imitative technology strategy, moving on to an international-imitative strategy and finally a defensive technology strategy as the firm matures, has proven to be more likely to yield positive results for the technological development of Chinese developing firms. Following a domestic-imitative technology

strategy at an early stage of development allows domestic firms to improve their technological capabilities relatively easy and at relatively low cost. It is also considered a comparatively easy strategy for the firm, as the knowledge gap between two domestic developing firms is likely to be smaller than it would be between a domestic and a foreign firm. It provides the firm with an incubation period, establishing an initial set of technological capabilities that can be built upon. For example in the case of Huawei, the initial phase as a domestic switch manufacturer allowed the firm to gain manufacturing capabilities that enabled the firm to subsequently reverse engineer and develop their first rudimentary technological skill sets. Similarly, TMT used the early development stages of the Chinese railway industry to build its skill sets by producing cheap and reliable products for the domestic market. Dependent on the domestic firms initial set of technological capabilities and internal resources, as well as external resources, it is possible to jump the domestic-imitative stage and start directly with an international-imitative technology strategy.

In order for a developing Chinese firm to successfully transition from a domestic to an international-imitative technology strategy it needs an initial set of technological capabilities that allow for the knowledge gap between the domestic and international firm to be overcome. Further, it needs access to foreign technology in order to be able to assimilate the advanced technology into its own set of technological capabilities. In order for this to be feasible the firm need to hold both sufficient external conditions and the necessary internal resources to be able to succeed.

For TMT gaining GE as a key account was the turning point in their technological development path and allowed the firm to move on to an international-imitative technology. This was made possible by the sufficient external conditions under which TMT operated in terms of the national institutional environment. Further, the firm's necessary internal resources, for example the firm's capabilities, supported the choice in technological strategy. In addition, TMT was fortunate to operate in the railway industry, which opposing to many other industries in China, was subject to a very consistent and well executed industry development strategy. It is as much a firm level success as it is an industry-level success of technological development in China. For

Huawei, it was a firm-level success, as they operate in an industry that discourages POEs to enter and yet Huawei succeeded.

One could reason that the theoretical considerations and empirical findings are, albeit coherent, out of date and to no use to developing Chinese firms of today. Under WTO rule and more stringent IPO enforcement, any imitative technology strategy would be significantly harder to implement. This might be the case for more established industries such as automobiles and consumer products. However, newer and less established industries, such as app based communication solutions, have generate a number of highly successful domestic Chinese firms which challenge established Western offerings not only in user numbers but also technological finesse and commercial success. And these firms did follow the same path to technological ascent. It is not only a question of IPO protection, but rather how the national institutions and mediating factors impact the firms' technological development. Here the historical lessons still apply, as for example, depending on the industry or location Western firms can still struggle to access the Chinese market allowing domestic firms to develop sheltered from direct advanced competition following an imitative technology strategy. The above stated example of communications solutions would apply, as Western firms struggle to comply with Chinese censorship rules or are cautious due to the sensitive information that needs to be shared. Further, depending on size and ownership of the domestic firm the Chinese stated actively supports certain firms in form of financial support or preferential market access (Harwit, 2008; Breznitz, 2011).

The path to technological ascent for developing Chinese firms can be considered successful when firms move away from an imitative to a defensive technology strategy. Once the firm reaches the position where it is advantageous to focus on defending its own technological achievements rather than acquiring external technology, it has moved away from being a follower towards being a leader. This is represented by an increasing number of patent applications from the firm, especially international patents. This progression can be seen in both of the case study firms researched. This technological 'coming of age' also is associated with expansion into international markets and becoming internationally competitive in the respective industry.

Research Question II: How did those Chinese domestic firms that succeed in developing superior organisational capabilities achieve it and to what extent have the National Institutions supported this process?

A clear path of technological ascent can be seen in both of the case studies, in accordance with the theoretical expectations that emerged from the literature review. Both, TMT and Huawei, started their path with a domestic-imitative technology strategy, followed by an international-imitative one, which ended in a defensive one. The transition from period to period was associated to crucial key moments in the firm's development history, but they were able to build superior capabilities because the choice in technology strategy was supported by both external and internal conditions.

In both cases the national institutions supported this development by providing access to finance, as well as access to large markets that were protected from domestic and foreign competition. However, the means by which this external support has been provided to each company differed. Whilst TMT, as an SOE was directly supported by national institutions through preferential access to foreign technology and a government protected strategic industry, Huawei as a POE operating in an underdeveloped rural location benefitted from the support of local and regional government. Furthermore Huawei benefitted from the governments laissez faire approach to enforcing IP rights to build their own technological capabilities through other firms' technology.

The next stage on the path to technological ascent saw both firms move on from a domestic-imitation strategy, to an international-imitation strategy. Their initial set of technological capabilities provided a strong foundation for technological development and the pursuit of a more challenging technology strategy. Both firms started to expand their wider organisational capabilities by adopting international best practice which facilitation this transition. Huawei, for example, invested heavily into upgrading its corporate governance capabilities through active learning from partners and external foreign consultancies. At this point in their development both case study firms greatly benefitted from the preferential award of financial resources through the national institutions. Further, due to their geographic locations – in close proximity to

centres of development - and the fact they operate in strategic industries, both firms enjoyed easy access to a pool of highly skilled labour and supplier networks, both foreign and domestic.

The final transition upon this path was the adoption of a defensive technology strategy once the firm had matured. Firms in this context have been able to establish themselves and develop extensive technological capabilities based upon access to domestic and then foreign technology. Utilising these assets, firms are able to grow and expand to the point where their size, importance and potential are recognised by the government. Seeking to capitalise on this for political and economic gain, the state ensures the firm is fully supported with financing, privileged access to markets, and skilled labour. With all of these benefits, combined with the improved technological capabilities, development of their own proprietary technology is both feasible and desirable.

Research Question III: Under what conditions, both external and internal, are Chinese domestic firms likely to develop superior organisational capabilities?

Over the course of analysing the path to technological ascent it was clear that there were four dimensions of differentiation between firms in terms of the external conditions and resources they encounter. The research establishes that the external and internal conditions for Chinese domestic firms to develop superior organisational capabilities are closely related to each other. However, the interaction and resulting interdependence between these external and internal conditions in China differ based on a variety of dimensions. These four dimensions are identified to be: (i) ownership, (ii) size, (iii) industry, and (iv) location.

First, ownership structures substantially impact the interactions between firms and national institutions in China. State-owned and private-owned enterprises compete against each other in a market in which SOEs enjoy strong state support, which results in good access to resources, whilst POEs lack such privileges. However due to lower state interference, POE's often have better corporate governance composition and standards. Second, size helps developing firms to cope with the uncertainties and constraints associated with the path to technological ascent. Smaller firms lack the

financial reserves to overcome these uncertainties and constraints. Third, in China industrial sectors are differentiated into strategic and non-strategic ones, and this categorisation determines the degree of state control exerted over it by the national institutions. Strategic industries are considered vital to the wider political and economic agenda of the government, and thus subject to high state interference and restricted entry to certain developing Chinese firms – particularly POE's. Yet, if access is obtained, lower levels of competition mean that they can offer a safe space for incubation of technological capabilities. In contrast, non-strategic industries in China are primarily market driven. Whilst benefitting from limited state interference and low access barriers, developing firms in these industries face higher levels of competition. Lastly, the specific geographic location of the firm in China affects the developing firm's ability to gain a variety of key resources. Developed coastal locations offer greater spill over effects from close proximity to foreign and domestic competitors, but remote rural locations offer a greater freedom from central government control. Both of these locations offer benefits and constraints for developing superior organisational capabilities, but the effects are dependent on the specific size and strategy of the firm.

In summary, developing Chinese domestic firms are either advantaged or disadvantaged in terms of their interactions with the national institutional environment according to their own composition of those four dimensions of differentiation.

Advantaged firms are being understood as the type of firm that is granted preferential treatment and access to resources through the Chinese institutions. Disadvantaged firms are being denied or offered less preferential access to these (see Table 38). However the extent of advantage or disadvantage varies according to a scale of their position against the four dimensions of differentiation.

This scale has been summarised in Table 29, from Major Advantage firms to Major Disadvantage firms. These different types of firms find diverse technology strategies both feasible and desirable, based on sufficient external and necessary internal conditions.

Table 29: Chinese domestic firm matrix and choices in technology strategy

Firm Type	Type of Domestic Chinese Firm	Technology Strategy
Major Advantage	Large sized strategic coastal Majority SOEs	Dependent Technology Strategy
Advantage	Large sized strategic coastal/inland Minority SOEs and POEs	International-Imitative Strategy
Approximate Parity	Large sized non-strategic coastal/inland Minority SOEs and POEs	Domestic-Imitative Strategy
Disadvantage	Small/Medium sized non-strategic coastal/inland Minority SOEs and POEs	Domestic-Imitative/No Technology Strategy
Major Disadvantage	Small/Medium sized non-strategic coastal/inland POEs	No Technology Strategy

This typology allows for a more accurate assessment of the likelihood with which certain types of Chinese domestic firms will become technologically successful. Large sized strategic/non-strategic coastal/inland minority SOEs and POEs are the type of firm most likely to pursue either a domestic-imitative or international-imitative technology strategy based on their setting within the four dimensions. Therefore, it can be assumed that these Chinese developing firms are the most likely the ones to be successful on the ideal path to technological ascent.

Limitations

There are, of course, limitations to this research design.

The depth of data required to gain a nuanced understanding of the linkages between the firm characteristics, national institutional context and technological capabilities requires in depth insights into firms development. This necessitated the in depth insights that only a case study approach can offer. However, due to abductive dual case study, and the focus of depth, rather than breadth, of analysis there is a limit to the extent of evidence for the other types of firms in the typology within this study. There is scope to further extend this research to a multiple case study approach, examining the empirically underdeveloped firm types. As a developed theory of four dimensions of differentiation, it is necessary to explore a wider range of test cases

across varying combinations of these factors to increase the accuracy and reliability of findings (Herriot and Firestone 1983; Eisenhardt and Graebner 2007). This would greatly contribute to theory robustness and development.

Additional research should also focus on those Chinese domestic firms that successfully transitioned directly into an international-imitative technology strategy, rather than first following a domestic-imitative strategy. Access to firms of this type was not possible at the point of this study, but this analysis would contribute greatly to understanding which external and internal preconditions are needed for Chinese developing firms to accelerate their innovation capabilities.

Further, the scope of research could be widened into other developing countries to assess the applicability of the ideal path to technological ascent for developing firms in other national institutional contexts. Research of this type would need to analyse if a joint framework can be developed, or if the individual national differences were too great. This would also allow for an assessment of applicability of the four-dimension framework outside of China. Further research could focus on assessment of the comparative degree of importance amongst the four dimensions within both the Chinese context, as well as in different national settings, which is something this research does not seek to investigate.

Practical Implications/Policy Implications

The research contributes to gain a better understanding of the technological development path for domestic Chinese firms, and impact of national institutions on the development of their organisational capabilities.

From an academic perspective the developed framework satisfies a gap in the literature for latecomer firms in developing economies, as well contributing to the stream of technology strategy literature. Furthermore, the four dimensions framework has implications for the improvement of the ability to predict the probability of Chinese developing firms to become technologically successful.

From a policy perspective, this information is valuable for both companies and governmental policy makers in terms of understanding the varying implications

associated with ownership structures, industry sector and geographical location in particular. Understanding the effects that change in policies to either encourage or constrain the development of companies in respect to these factors allows for more accurate and effective measures to be introduced. For example the government may well wish to stimulate greater technological ascent of developing firms in China and can use this framework to identify 'untapped' sources of innovation, either by reigning in control or by offering state resources in a different way.

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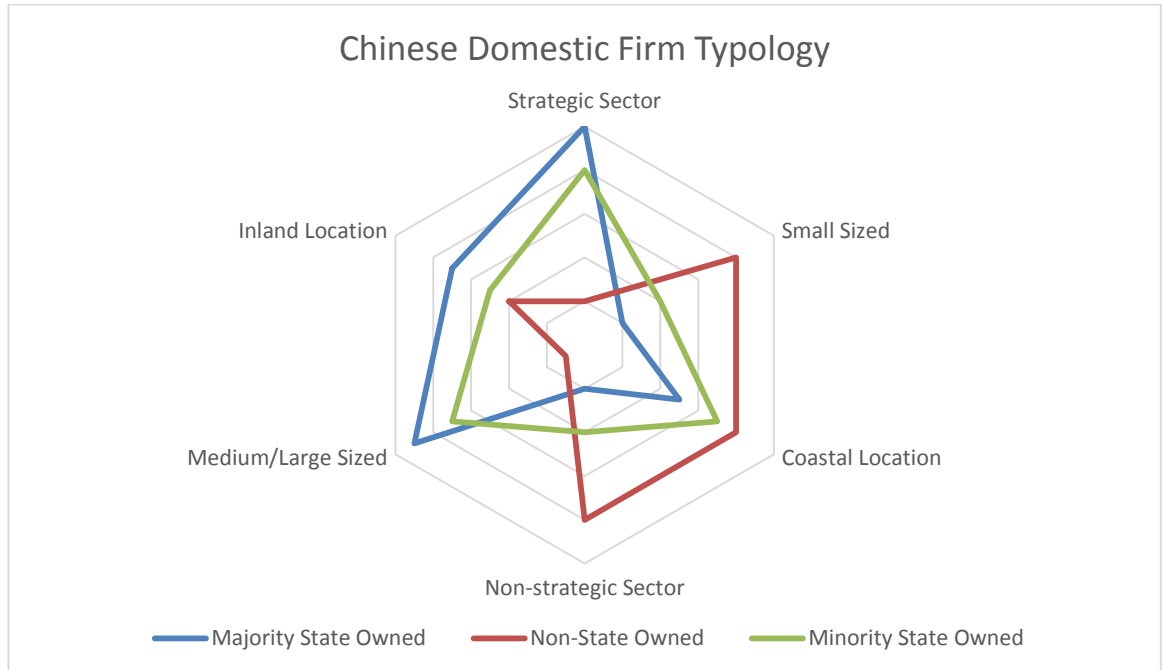
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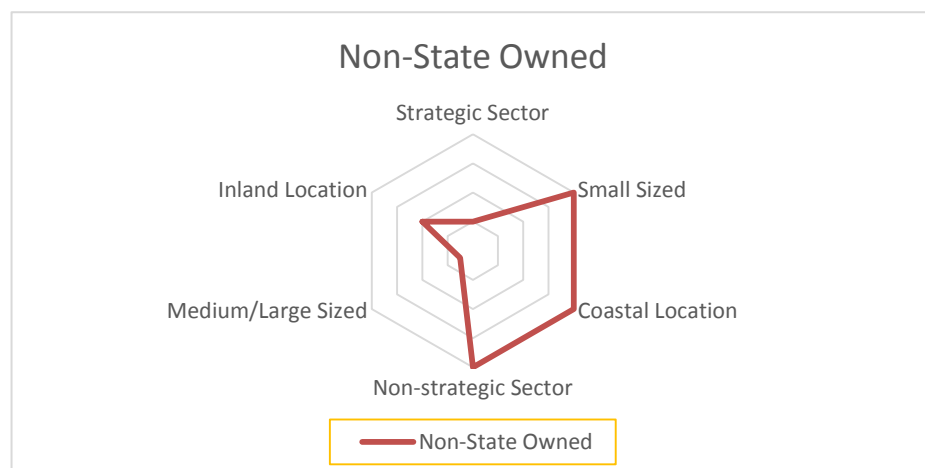
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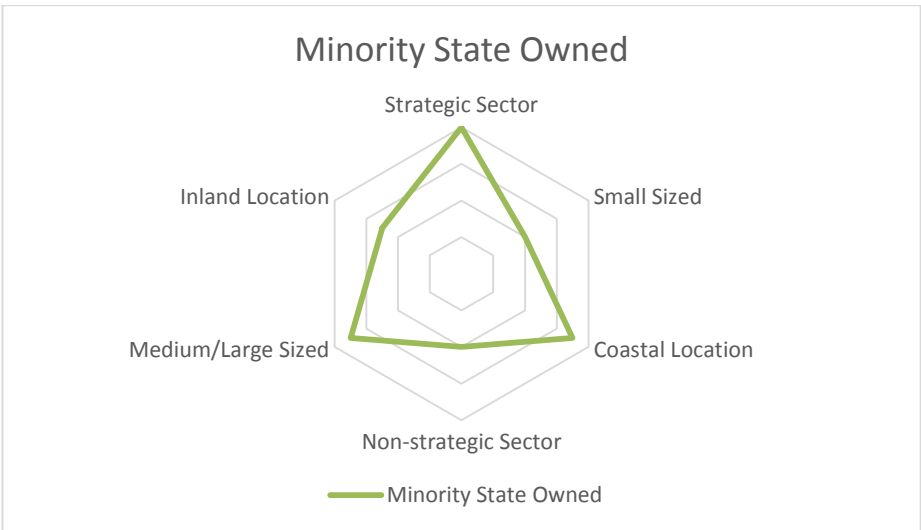
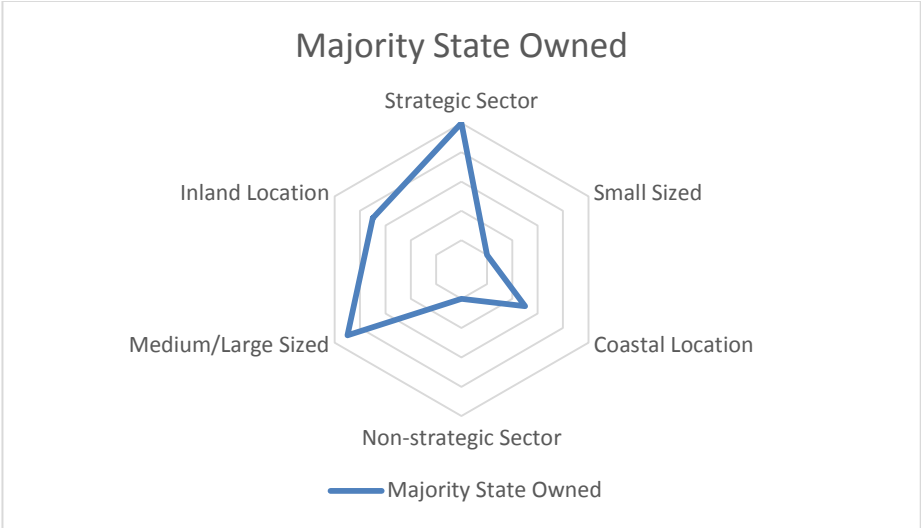
Appendix

Visualisation Chinese Domestic Firm Typology



	Majority State Owned	Non-State Owned	Minority State Owned
Strategic Sector	High	Low	High
Small Sized	Low	High	Medium
Coastal Location	Medium	High	Medium/High
Non-strategic Sector	Low	High	Medium
Medium/Large Sized	High	Low	Medium/High
Inland Location	Medium/High	Medium	Medium





Interview Schedule

The below interview schedule has guided the data collection of the empirical work of this thesis. The below gives an overview of the questions of each of the categories applied. Questions that have informed the empirical findings of this work are marked in bold, while questions that are additional to the final applied framework are highlighted in italic.

A. COMPANY PROFILE

Ownership

A.1.1 What is the firm's current legal status?

- 1 Shareholding company with shares traded in the stock market
- 2 Shareholding company with non-traded shares or shares traded privately
- 3 Sole proprietorship
- 4 Partnership
- 5 Limited Partnership
- 6 Other (please specify)

A.1.2 What percentage of this firm is owned by each of the following:

- 1 Private domestic individuals, companies, or organisations
- 2 Private foreign individuals, companies, or organisations
- 3 Government or state (please specify local, regional, or national)
- 4 Other (please specify)

A.1.3 *Who are the current shareholders and what percentage do they hold?*

A.1.4 What roles, if any, do any owners, or their representatives play in the day-to-day management of the enterprise?

A.1.5 *What role do owners play in the strategic direction of the enterprise?*

A.1.6 Do any managers or other employees hold shares in the enterprise and, if so, how many?

A.1.7 How are these shares valued and can they be sold? And do these shares come with formal or informal veto rights?

A.1.8 Which other organisations and/or individuals play a major role (e.g. initiating or vetoing financial policies, product and technology changes, senior personnel changes etc) in the strategic direction of the enterprise, and how?

A.1.9 How often are these other organisations consulted and who initiates this contact?

A.1.10 *Do any of the owners, or their representatives, have powers of veto over:*

1. Capital expenditure? If so, which?
2. New product or service introduction? If so, which?
3. Top management appointments or nominations? If so, which?
4. Creating or closing down a department or subsidiary? If so, which?

A1.11 Who are the major lenders? And how is the relationship between lender and firm organised, e.g. how are loans obtained?

A.1.12 How often does the enterprise have to report results, and of what kind, to which major creditors?

Creditor	Frequency	Results of:
----------	-----------	-------------

A.1.13 *How often did the major bank(s) contact the enterprise each month, on average?*

A.1.14 *Which services did the major bank(s) provide for the enterprise? And how are banks chosen for each service?*

A.1.15 Does the enterprise have a main bank with which it has preferential relations on a medium to long term, i.e. over 1 year, basis? Which and how does the relationship work?

Product lines and technology

A.2.1 What percentage of the firm's sales had been:

- 1 Regional Sales (is there a free trade between different regional areas?)
- 2 National Sales
- 3 Direct Exports

A.2.2 In which year after establishment did the firm export products for the first time?

A.2.3 *What are the key (10% of sales) products and services offered by the enterprise?*

A.2.4 Based on which technology have these products initially been developed and how was it obtained? (e.g. internally via R&D or externally via Joint Venture or acquisition)

A.2.5 Which of these main product lines were offered five years ago, and how significant were they?

A.2.6 Which products/services were offered five years ago and are not now? And for what reason have they been discontinued?

A.2.7 *In the last five years, has the firm introduced any new products?*

A.2.8 *What percentage of this firm's total annual sales are these products accountable for by now?*

A.2.9 Which of today's outputs are modified to suit particular customers?

No. of output from A.2.3

- | | |
|--|-------|
| a) Standard line | _____ |
| b) Standard line with standard modifications | _____ |
| c) Standard but modified to customer specification | _____ |
| d) Output entirely to customer specifications | _____ |

A.2.10 Output Processing

Number of output

Which outputs are:

a) Used by other producers for other outputs (intermediate goods) _____

b) Sold to consumers, directly or indirectly (finished goods) _____

c) Both _____

A.2.11 *How are these outputs likely to change in the next 12 months? And will the product composition remain or change, too?*

A.2.12 **What is your estimated market share for your 3 most important outputs?**

Local Market

National Market

Worldwide

A.2.13 Changes in Employment

Please give the numbers of employees in each of the following categories.

Type of Employee	Number today	Number 5 years ago
Direct production workers personally providing the service or producing the outputs		
Skilled		
semi-skilled		
Unskilled		
First line supervisors (not directly engaged in production)		
Total line management, above first line supervisors, responsible for work outputs		
Total non-workflow personnel - all those with no direct or supervisory responsibility for work outputs		
Clerical workers - non workflow personnel whose main task is writing and recording		
Technical support personnel - non workflow personnel whose main task is the provision of support services to workflow employees		
Total		

A.2.14 **Number of staff engaged in research and development?**

A.2.15 *In what ways has this firm introduced new products or services?*

1 Introduced your own version of a product already supplied by another firm

2 Developed in cooperation with suppliers

3 Developed in cooperation with client firm

4 Implemented ideas from internal R&D

5 Implemented ideas from external source, e.g. consultants, universities, or research institutions

6 Developed or adapted in house

A.2.16 **How much has the firm spent on research and development activities performed in house on average annually?**

How would you rank the above firm expenditure in comparison to other competitors?

A.2.17 Number of new products/services introduced in this year in comparison to your main competitors?

A.2.19 Does any other organisation undertake R&D which is used by the enterprise? If so, which and how does the relationship work and could you give an example?

A.2.20 If so for what reasons? (e.g. cost advantage or lack of in-house capabilities)

A.2.21 Is external R&D considered to be of less value to the firm than internal one? And if so why?

A.2.22 How much did the firm spend on research and development activities contracted with other companies on average annually?

A.2.23 How much of this external research and development activities has been conducted with domestic firms and how much with foreign ones?

A.2.24 Over the last five years, what type of innovation activities has the firm engaged in?

1. Developing or modifying the technology for production
2. Purchasing new production equipment?
3. Introduce new quality control procedure in production or operations
4. Introduce new managerial/administrative processes
5. Provide technology training to staff
6. Introduce new product or service
7. Add new features to existing products or service
8. Take measures to reduce production costs through increased efficiency
9. Take actions to improve production flexibility

A.2.26 Please list the members of top management, and their positions, five years ago and now, (draw chart if possible)

A.2.27 What percentage of today's middle management and technical staff (between first line supervisor and Department Director level) have changed in the last five years?

A.2.28 How important are the following objectives in making strategic choices?

	Very Important					Unimportant
a) Increasing output	1	2	3	4	5	
b) Increasing earnings per share	1	2	3	4	5	
c) Increasing quoted share price	1	2	3	4	5	
d) Increasing sales growth	1	2	3	4	5	
e) Increasing market share in major product markets	1	2	3	4	5	
f) Increasing the rate of new product/service introduction	1	2	3	4	5	
g) Improving quality and performance of outputs	1	2	3	4	5	
h) Improving employee skill	1	2	3	4	5	
i) Increasing employee productivity	1	2	3	4	5	
j) Reducing production costs	1	2	3	4	5	

- | | | | | | |
|---------------------------------|---|---|---|---|---|
| k) Reducing direct labour costs | 1 | 2 | 3 | 4 | 5 |
|---------------------------------|---|---|---|---|---|

A.2.29 To what extent do the following statements correctly describe the enterprise's current strategies?

	Definitely True				5	Definitely Incorrect
1. Diversification is closely linked to current technologies and markets	2	3	4	5		
2. Sales growth is more important than short term profitability	1	2	3	4	5	
3. Shareholder wealth maximisation is the dominant goal (in long-term)	1	2	3	4	5	
4. Resources are concentrated in a few market segments	1	2	3	4	5	
5. Low cost production is crucial to survival and growth	1	2	3	4	5	
6. Recruitment of technical and managerial staff is based on long term personnel planning	1	2	3	4	5	
7. Subsidiaries are divested when they perform badly	1	2	3	4	5	
8. New resources and know-how are better acquired than developed internally	1	2	3	4	5	
9. Developing employee skills and commitment is a key strategic goal	1	2	3	4	5	

A.2.30 What are the major sources of competitive advantage at the moment?

	Very important				5	Unimportant
a) low prices	1	2	3	4	5	
b) fast delivery	1	2	3	4	5	
c) high quality design and performance	1	2	3	4	5	
d) good after-sales service	1	2	3	4	5	
e) ability to produce to customer requirements	1	2	3	4	5	
f) high quality advertising and publicity	1	2	3	4	5	
g) other?						

A.2.31 What are the major constraints in undertaking new developments?

A.2.32 How is it possible for the enterprise to manage risks in undertaking new developments? Can they be shared with other organisations or groups? If so, which and how?

A.2.33 How far ahead is it feasible for the enterprise to plan activities? What factors affect this?

B. MARKET ORGANISATION

Relations with Customers

B.1.1 Who are the three largest customers (i.e. accounts for greatest percentage of total output), and how much of your output do they buy?

B.1.2 How have these changed in the last five years?

B.1.3 *To what extent does your largest customer depend on your supplies?*

B.1.4 What informal and formal connections does your enterprise have with:

B.1.5 *What are orders from your largest customer placed on:*

B.1.6 *How do you obtain new customers and increase sales?*

B.1.7 How do you evaluate the trustworthiness of new customers?

B.1.8 How do you set prices for new customers?

(e.g. rely on industry averages, average cost plus allowance for profit, special price for new customers, marginal costs plus profit)

B.1.9 How much credit do you extend, and on what basis, to your customers

B.1.10 How do your major customers select suppliers?

B.1.13 When you start trading with a new customer, do you always hope to establish a long term relationship with them?

YES/NO

What does this depend on?

B.1.14 *To what extent do your major customers change their order levels as it suits them, without regard to suppliers' needs for order stability and continuity?*

1 2 3 4 5

A great deal

Rarely

B.1.15 **To what extent do agreements with customers specify in detail payment terms, delivery arrangements, procedures for price changes and other contingencies?**

1 2 3 4 5

A great deal

Hardly at all

B.1.16 *When undertaking a new order, do you:*

- a) Quite often start production before a written purchase order form is received,
or
- b) Sometimes start production before a written purchase order form is received,
or
- c) Never start production before a written purchase order form is received?

B.1.17 To what extent do your major customers check your supplies?

- a) Thorough 100% or sample checks for all part numbers by customer on delivery.
- b) Some (less than half) part numbers receive no inspection on delivery.
- c) Over half of part numbers receive no inspection on delivery.

B.1.18 How much communication do you have with your major customers?

- a) Infrequent (i.e. once or twice a year) and largely formal,
- b) Monthly or more often, but strictly focused on business concerns,
- c) Frequently, involving a number of different people and often including social events.

B.1.19 Are production and replenishment plans shared with your customers?

B.1.20 *Are finished goods inventory shared with your customer?*

B.1.21 To what extent do your major customers transfer technical expertise to your enterprise?

- a) Pooling of technical expertise has rarely occurred;
- b) Some pooling of technical expertise has occurred;
- c) Much unilateral or bilateral technology transfer has taken place, without any attempt at costing or claiming payment for it.

B.1.22 When unforeseen contingencies arise, such as changes in new raw materials costs, do your major customers typically:

- a) expect you to bear all the risks involved;
- b) share some of the risks with you;
- c) usually share the risks with you?

B.1.23 *Who is responsible for customer relations within the firm? How many people are involved?*

Relations with Suppliers

B.2.1 *Who are your major suppliers (in terms of % of input costs)*

B.1.15 To what extent do agreements with suppliers specify in detail payment terms, delivery arrangements, procedures for price changes and other contingencies?

B.1.16 When undertaking a new order, does your supplier:

- a) quite often start production before a written purchase order form is received, or
- b) sometimes start production before a written purchase order form is received, or
- c) never start production before a written purchase order form is received?

B.1.17 To what extent do you check your incoming orders from your suppliers?

- a) Thorough 100% or sample checks for all part numbers by suppliers on delivery.
- b) Some (less than half) part numbers receive no inspection on delivery.
- c) Over half of part numbers receives no inspection on delivery.

B.1.18 How much communication do you have with your major suppliers?

- a) Infrequent (i.e. once or twice a year) and largely formal,
- b) monthly or more often, but strictly focused on business concerns,
- c) frequently, involving a number of different people and often including social events.

B.2.6 How dependent are your major suppliers on your orders?

B.2.7 Do you share your demand forecast with your supplier?

B.2.9 *Do you share your raw material inventory with suppliers?*

B.2.10 If alternative suppliers offered you inputs that were either cheaper than currently available or else performed better, would you:

- a) switch your order to the new supplier within weeks?
- b) ask existing supplier to match the new offer within 6 months?
- c) work with existing supplier to match new offer within 1 year?

B.2.11 *Do you actively seek new suppliers? If so, how?*

B.2.12 How much credit do your major suppliers give you?

B.2.13 *When considering developing new products or services, how are you constrained or guided by existing relationships with suppliers?*

Relations with Competitors

B.3.2 Which are the main competitors in your major industry?

Local Market	National Market	Worldwide
--------------	-----------------	-----------

B.3.3 *Are there many competitors in your main market?*

B.3.4 *Are unregistered or informal firms effecting your operations? And if so in what ways and how are you dealing with it?*

B.3.5 *Do you belong to any trade or industry associations in your country or worldwide? If so, which?*

B.3.6 *What functions do these perform?*

B.3.7 Do you collaborate with any of your competitors in new developments and share information with them? If so, how and over what period?

B.3.8 Do you organise joint representations to state ministries and agencies? If so, how?

B.3.9 Do you co-operate with competitors in setting wage rates and other employment policies, including training? If so, how?

B.3.10 Do you co-operate with competitors in seeking export markets?

B.3.11 How important, and in which ways, is the reputation of your enterprise in the industry to business success?

B.3.12 *How do you keep track of your competitors' activities?*

B.3.13 How do competitors' actions affect your strategic choices? Can you give some recent examples?

B.3.14 Have you recently hired staff from your competitors? If so, how many and in what areas?

B.3.15 How common is movement of skilled workers, technicians and managers between enterprises in your industry? How does this affect personnel policies?

Business-Government Relations

B.4.1 *To what extent do you agree with the statement that "the court system is fair and uncorrupted"?*

B.4.2 How are legal disputes between firms addressed?

B.4.3 How are legal disputes between the firm and state entities addressed?

B.4.4 *Does the firm has an in-house legal department? If so how many people does it employ?*

B.4.5 In a typical week, what percentage of senior management's time was spent on dealing with formal requirements imposed by government regulations?

B.4.6 How often is the firm in contact with the local government authorities? And who initiated this contact?

B.4.7 Who is dealing with government authorities within the firm?

B.4.8 Has the firm been inspected/visited by government officials or been requested to meet with them? And if so for what purpose?

B.4.9 *Has the firm been visited or inspected by tax officials? Or called in by them?*

B.4.10 Has this firm secured or attempted to secure government contracts?

B.4.11 *It is said that firms are sometimes required to make gifts or informal payments to public officials to "get things done" with regards to customs, taxes, licences, regulations, etc. – On average, what percentage of total annual sales do firms like this one pay in informal payments or gifts to public officials for this purpose?*

B.4.12 **HELP OF GOVERNMENT – legal aid, government procurement, access to money, raw materials markets etc.**

B.4.13 To what degree are the below aspects an obstacle to the current operations of this firm?

- 1 Tax rate levels
- 2 Tax administrations
- 3 Business licensing and permits
- 4 Frequency of change in political personnel
- 5 Corruption
- 6 Courts
- 7 Trading barriers between local regions
- 8 Market access
- 9 Government product standards

C. CO-ORDINATION AND CONTROL

The Overall Configuration

- C.1.1** Please describe the major units of the organisation and their activities (preferably with chart).
- C.1.2** How have these changed in the last five years?
- C.1.3** How interdependent are these units? How do their activities depend on inputs from other units?
- C.1.4** *How are their activities co-ordinated?*
- C.1.5** To what extent do managerial and technical staff move between these units, and for how long? Can you give some recent examples? Who decides on, and organises, these transfers?
- C.1.6** *Are any of the following integrative devices commonly used to co-ordinate the activities of these units?*
- a) Temporary or permanent individual co-ordinators integrating activities of two units.
 - b) Ad Hoc groups of co-ordinators integrating activities of more than two units.
 - c) Permanent teams co-ordinating activities of many units.
- C.1.7** How is the performance of these units assessed? And how often?
- C.1.8** How are the heads of these units selected? On what criteria, by whom and for how long do they stay in post?
- C.1.10** *How often does each unit have to report to the Chief Executive, and what about?*
- C.1.11** *How are new units established or closed?*

Centralisation

- C.1.13** In terms of levels of authority, six major ones in all firms can be identified. Please give examples of the following in your enterprise.
- 6 Above the Chief Executive (e.g. Supervisory board, controlling shareholder)
 - 5 Whole Unit level (e.g. Chief Executive, Executive Board)
 - 4 Business/Functional Unit level (e.g. senior managers in charge of major divisions or departments who report to Chief Executive)

- 3 Workflow Activities level (e.g. manager responsible for range of activities producing outputs such as factory managers)
- 2 Workflow sub-unit level (e.g. responsibility for part of workflow or function within factory or office)
- 1 Supervisory level (e.g. responsible for managing operating staff, but not engaged in direct work)
- 0 Operator level. Direct work either on products or supporting service

C.1.14 *What is the most junior level at which the following decisions can be taken so that action follows, without waiting for confirmation from above?*

a) Who takes over in the Chief Executive's absence?

Job title:

In practice what is the most junior level:

- b) Alter the responsibilities or areas of work of specialist staff departments**
- c) Alter the responsibility or areas of work of line management departments.**
- d) Create or close a department or major organisational unit.**
- e) Create a new job**
- f) Decide on a new product or service.**
- g) Decide on the pricing of outputs**
- h) Decide on the priority of orders**
- i) Decide on suppliers**
- j) Allocate work to operators**
- k) Decide which machinery/equipment is to be used**
- l) Decide on the method of work to be used**
- m) When overtime will be worked**
- n) Decide who represents the enterprise in labour disputes**
- o) Decide on labour force requirements**
- p) Decide on personnel selection methods**
- q) Decide on appointment of operators**
- r) Decide on appointment of supervisors from outside the enterprise**
- s) Decide on promotion of operators**
- t) Decide on promotion of supervisors**
- u) Decide on training methods and allocation of training resources**
- v) Decide on nature of costing system**
- w) Decide on what shall be costed**
- x) Decide how to allocate unbudgeted funds**

C.1.15 Do some or all managerial personnel have formal job descriptions? Can you give examples?

C.1.16 Do some or all technical and clerical staff have formal job descriptions?

C.1.17 Is there a standardised performance appraisal system in operation for managerial jobs? If so, how does it work?

C.1.18 How many staff (not secretaries) report to the Chief Executive?

C.1.19 How many levels of authority exist between operators and the Chief Executive?

Labour Management and Employment Policies

C.2.1 How many permanent full-time individuals in this firms are:

- 1 Production workers
- 2 Non-production workers

(pilot study only!)

C.2.2 *How many permanent full-time individuals in this firms are:*

- 1 Skilled production workers
- 2 Unskilled production workers

(pilot study only!)

C.2.3 **How are new manual workers recruited? Who decides how formal is the process, how are they selected etc. Are references required, formal interviews held, by whom?**

C.2.4 *How are new supervisory, technical and managerial staff recruited?*

C.2.5 *Are new staff recruited to fill specific posts, or more to join the organisation for a variety of roles?*

C.2.6 **Are there different kinds of employment contracts/agreements for different groups of employees (e.g. by skill, gender, age, temporary/permanent etc)? If so, please give examples and members involved.**

C.2.7 **What proportion of current employees have been with the firm since leaving full time education?**

C.2.8 **What is the average number of years of education of a typical full-time individual employed in this firm?**

- 1 Production worker
- 2 Non-production worker

C.2.9 **What was the level of labour turnover in the last 12 month and five years ago??**

C.2.10 *How many people were made redundant in the last 12 months? And generally speaking for what reasons?*

At which levels of the enterprise?

- Top management
- Middle management
- Technical support
- Supervisory
- Clerical
- Skilled
- Unskilled

C.2.11 **Which groups of employees are crucial to the enterprise's future and how do you ensure their continued commitment?**

C.2.12 **What proportion of total job vacancies were filled internally in the last twelve months?**

C.2.13 *What proportion of managerial jobs were filled internally in the last twelve months?*

C.2.14 **How are promotions decided for manual workers?**

- C.2.15** How are promotions decided for technical and managerial staff?
- C.2.16** How often, and in what way, are manual workers evaluated?
- C.2.17** How often, and in what way, are technical and managerial staff evaluated?
- C.2.18** How does such evaluation affect pay and other rewards?
- C.2.19** How many employees changed jobs within the firm in the last twelve months?
 - a) manual workers
 - b) clerical workers
 - c) technical staff
 - d) managerial staff

Training

- C.2.20** How much and what type training is given to new recruits?
 - a) manual workers
 - b) clerical workers:
 - c) technical workers:
 - d) managers:
- C.2.21** *How many days of external training were provided by the enterprise in the last 12 months?*
 - a) manual workers:
 - b) clerical workers:
 - c) technical workers:
 - d) managerial staff:
- C.2.22** *How many days of internal training were provided by the enterprise in the last 12 months?*
 - a) manual workers:
 - b) clerical workers:
 - c) technical workers:
 - d) managers:
- .2.23** How are people selected for training off the job?
- C.2.24** How is such training related to promotion and other rewards?

Pay and Rewards

- C.2.25** How is pay decided (i.e. individual output, time, experience, certified skills, superiors' evaluations, job grade, group output, company results etc) for:
 - a) unskilled workers:
 - b) skilled workers:
 - c) clerical workers:
 - d) technical staff:
 - e) managers:
- C.2.26** What other rewards are offered? (e.g. holidays, sickness pay, pensions)
- C.2.27** How does seniority in this enterprise affect pay?

C.2.28 How do external "market" pay rates affect wages and other rewards? For which jobs or skills?

C.2.29 How do public certificates of skills and education affect pay rates?

C.2.30 *What is the annual income differential between:*

a) First line supervisor to operator:

b) Technician to operator:

b) All white collar staff and all manual workers:

d) University educated staff to non-university educated staff:

Employee Representation

C.2.31 Are there any trade unions in the firm?

C.2.32 What % of employees are members?

C.2.33 What bargaining rights do they have?

C.2.34 *What other rights do they have?*

C.2.35 Are there any other forms of employee representation? If so, which and how do they work?

C.2.36 Generally speaking, through what means do manager/owners communicate to employees?

C.2.37 *Who is responsible for industrial relations in the enterprise? At what level are decisions taken about them?*

C.2.38 *What role does the personnel management department play in the firm? And how many people are involved in it?*

C.2.39 *How many foreman/work group leaders are selected and promoted from production workers?*

C.2.40 *How many foremen are former production workers?*

C.2.41 *How many supervisors (above foremen) are former production workers?*

C.2.42 What is the typical span of control for first line supervisors/foremen?

Control

C.3.1 Is performance assessed more at the individual or at the work group level?

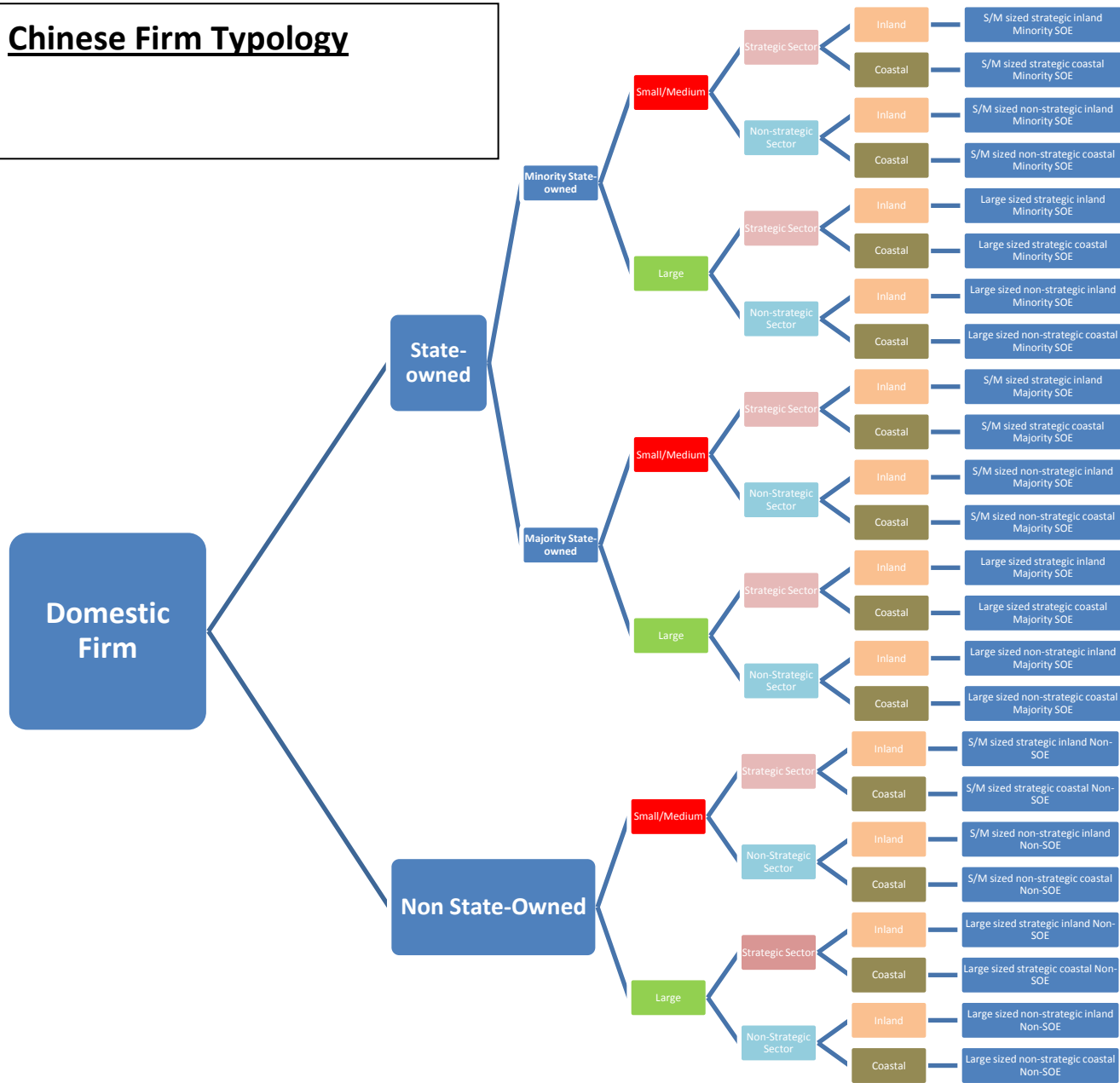
C.3.2 How important is the maintenance of high group morale and commitment in evaluating managerial performance? How is it assessed?

C.3.3 How closely involved in work group activities are supervisors in general expected to be?

- C.3.4** *To what extent do supervisors bear the primary responsibility for deciding which tasks operators should carry out?*
- C.3.5** *To what extent are supervisors expected to decide how tasks are to be performed?*
- C.3.6** **How responsible are supervisors for evaluating task performance and allocating rewards to workers?**
- C.3.7** **If they are not particularly responsible for allocating rewards to individuals, how is this decided?**
- C.3.8** *How much are supervisors expected to deal with non-task issues and concerns of work group members?*
- C.3.9** *Are supervisors expected to socialise with workers out of working hours?*
- C.3.10** **Are supervisors expected to develop strong personal ties to members of their work groups?**
- C.3.11** **Are managers expected to be more knowledgeable on most issues than their subordinates?**
- C.3.12** **Are managers expected to involve subordinates in decision making?**

(Chinese version of the interview schedule is available upon request.)

Chinese Firm Typology



Overview Chinese Legal System:

1) Does lobbying take place before the approval of the law or after or both?

Not Lobbying in a Western sense of the meaning – the creation process of laws often involves “testing periods” in certain local or provincial areas. Has a law proven to be effective the Supreme Court will take it up and turn it into a national law

2) The degree of discretion of the judicial system and various state organizations to interpret laws?

Each court – on all levels as illustrated in point 12 – have Judicial Committees, which do supervise the implementation of laws and judges in general. Further the respective higher-level of jurisdiction controls/supervises the next lower-level of courts in this respect.

Periodic “clean ups” from a central level to lower levels in regards to such implementation guidance and local/provincial laws

Judges have a high degree of discretion to interpret laws with them being supervised by the respective President of their court – see selection mechanism point 9.

3) Separation of civil law from other branches of law (eg. Penal, employment, etc.)

In China law has been, with beginning of the Open Door Policy, disaggregated into substantive areas. These areas are as below:

- i. Family Law
- ii. Civil Law
- iii. Criminal Law
- iv. Administrative Law [Hurst, 2011]

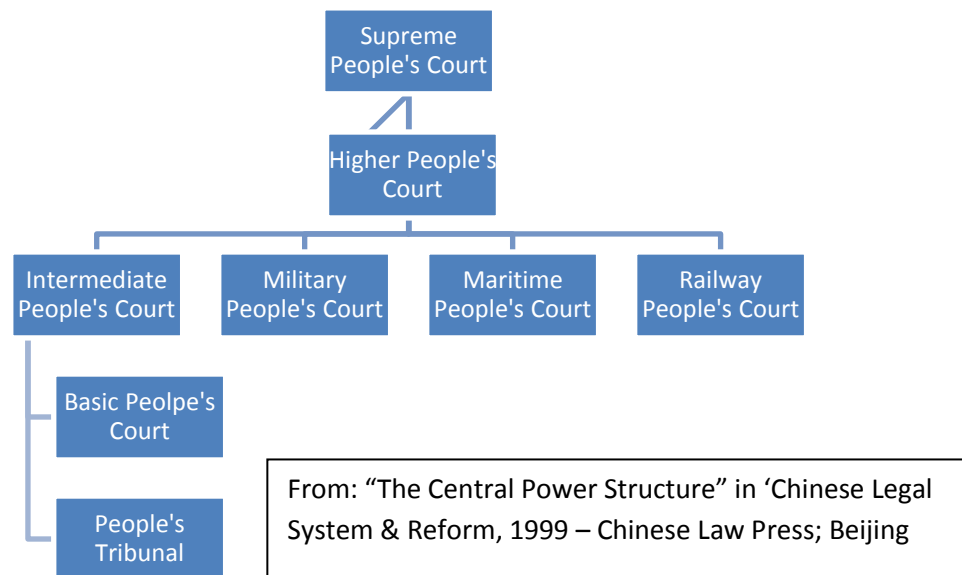
These general areas then have been further been divided into sub-areas such as e.g. Contract Law etc. – Also there is a special set of regulations covering cases involving “foreign subjects”.

4) Selection mechanisms for members of the judicial bodies (especially judges)

- Judges
- Judge Law been promulgated in 1995
- Lawyers until recently had been state employees (double check; Oggletree p.58 article on legal aid)
- Judges get appointed through patronage & not by their abilities (Oggletree p.59 article on legal aid)
- Qualifications as below:
 - A citizen of the PRC
 - At least 23 years of age
 - Supports the constitution of the PRC
 - In good, political, professional & moral standing

- In good health
 - A graduate from a higher institution of learning in law OR a non-law graduate from an institution of higher learning with in-depth knowledge of law & two years working experience
 - A clear criminal record & must not have been dismissed from any public office
- Appointment of Judges
 - Presidents of local & provincial courts are elected by the & removed by the People’s Congress of the respective level [their tenure is the same duration as the one of the People’s Congress]
 - President nominates: Vice-President, members of the Judicial Committee, presiding & deputy-judges for appointment & removal by the People’s Congress of same level
 - Primary & Assistant judges are recruited from among qualified candidates through public examination
- Promotion of Judges
 - Judges are divided into 12 levels – the President of the Supreme People’s Court being the Chief Justice. Levels are determined by: the judge’s position, performance, professionalism, and seniority.
 - Promotions are based on annual performance reviews conducted by the courts where the judges serve
 - Performance reviews (or so formulated in the according regulation) “shall be conducted in an objective, impartial manner and combine evaluations by both superiors and subordinates.

5) Structure of courts & differentiation of courts



- Form of court trials:
 - Grassroots Tribunal – minor civil or criminal cases
 - Sole Judge Court – 1st hearing of simple civil & minor criminal cases

- Collegiate Panel – 1st hearing of civil & criminal cases & always hearing of administrative cases.
Consists of three judges – Presiding judge appointed by president ruling via majority principle; any minority voting shall be reflected in the records.

6) Appeal procedures

- In general the rule of second instance being final is followed in the Chinese legal system, following the different levels of courts as outlined in point 13 – meaning that is a Basic People’s Court ruling is appealed to it will be then dealt with in the next higher instance of Intermediate People’s Court etc.
- Supreme Court rulings differ as they are final within their first instance
- System of judicial supervision:
 - Also known as system of re-examination – if a ruling is proven to be false or the proceedings to contain errors – rulings can be appealed to
 - The procedure can only be initiated by the president of the court in question – then it will be handed over to the Judicial Committee
 - If they approve the case will be re-tried under a different collegiate panel.

7) Allocation of cases to particular judges

Cases are allocated to judges via the president of the respective local or provincial court. Generally speaking cases are tried in the respective jurisdiction of those filing for the trial.

The mode of trial is dependent on the details of the case – administrative cases always will be dealt with by a collegiate panel while minor civil or criminal cases might be handled by a sole judge court or the local grassroots tribunal.

8) Non-court based legal instruments

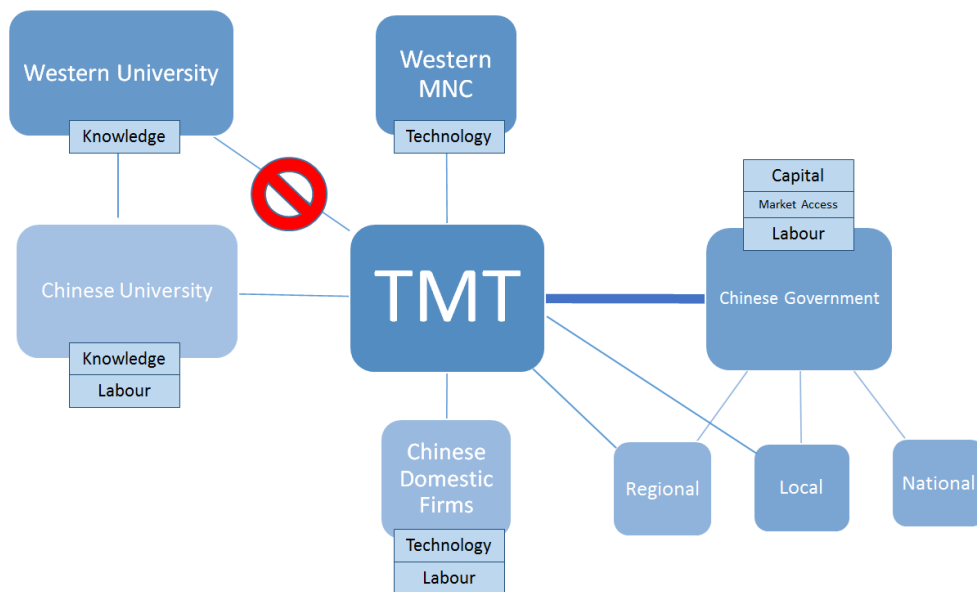
- Tribunal Courts – on local & provincial level
- Arbitration

9) Need for legal representation

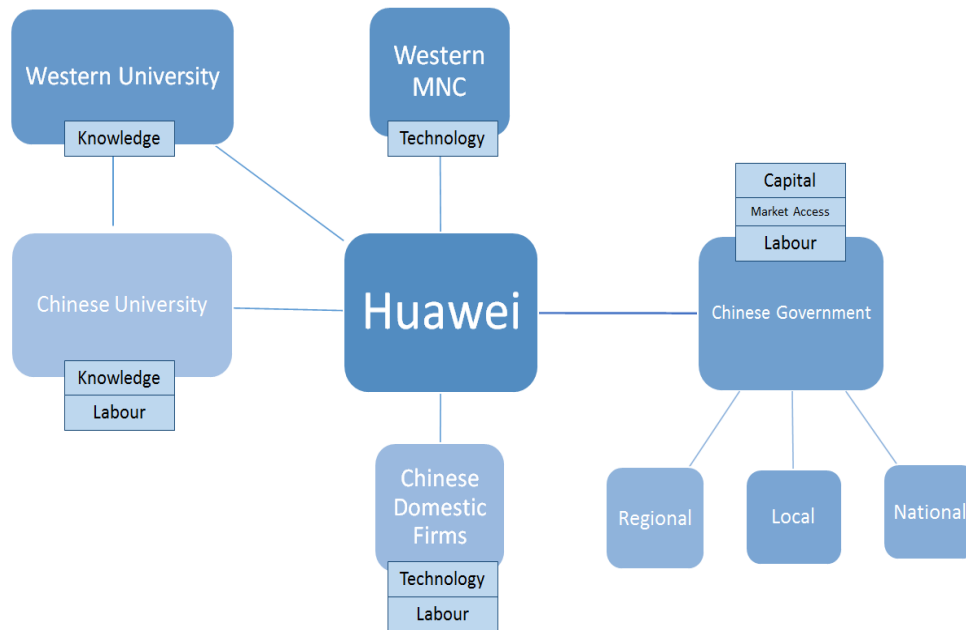
- Defence System – entitled to legal representation
- Accused or suspect can choose to defend himself (except: if a public prosecutor is involved)
- Those eligible to defend the accused are:
 - Lawyers
 - Persons recommended by people’s organisations or the employer of the accused
 - The custodian or relative of the accused or suspect

- If a public prosecutor is involved – or the suspect is blind, mute, deaf or minor – a legal-aid lawyer will be provided free of charge if the suspect cannot afford to pay legal representation.
- Also legal representation is mandatory in cases involving the death penalty – legal aid in this case will also be provided
- Problem with legal aid: legal aid programmes differ significantly in scope and degree of professionalism throughout the country. Often are not present at all in rural areas – as this matter is dealt with on a local level. E.g. Beijing has a rather developed legal aid scheme with law firms being obligated to provide legal aid with work force on a rotational basis. Firms can choose to opt out of this duty if they pay an annual fee into the legal aid fund of the city.

Zhuzhou Times New Materials in the wider Chinese Institutional Context



Huawei in the wider Chinese Institutional Context



Huawei Core Values

According to Huawei’s own internal and external communications its core values are stated to be the following: (i) customers first, (ii) dedication, (iii) continuous improvement, (iv) openness and initiative, (v) integrity, and (vi) teamwork.

Customers First: Huawei exists to serve customers, whose demands are the driving force behind our development. We continually create long-term value for customers being responsive to their needs and requirements.

Dedication: We win customers’ respect and trust primarily through dedication. This includes every effort to create value for customers and improve our capabilities.

Continuous improvement: Continuous improvement is required for us to become better partners for our customers, improve our company, and grow as individuals. This process requires that we actively listen and learn in order to improve.

Openness and initiative: Driven by customer needs, we passionately pursue customer-centric innovation in an open manner.

Integrity: Integrity is our most valuable asset. It drives us to be honest and keep our promises, ultimately winning our customers’ trust and respect.

Teamwork: We can only succeed through teamwork. By working closely in both good times and bad, we lay the foundation for successful cross-cultural collaboration, streamlined inter-departmental cooperation, and efficient processes.

The Interaction between Chinese National Institutional Context and Firms – An Overview Matrix

