



# How Variations in Business Systems Affect the Innovativeness of Chinese Firms

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## How Variations in Business Systems Affect the Innovativeness of Chinese Firms

### Historical Background, Framework, and Case Studies

*Jiajia Liu and Andrew Tylecote*

#### INTRODUCTION

In this chapter we look at how three features of current business systems that have evolved during the reform process since 1978 in China—governance and finance, work management practices and inter-firm relations—shape the technology strategy of Chinese firms. Our theoretical framework is drawn from three streams of literature. The first begins with Freeman’s typology of technology strategies (1995), formulated originally for advanced countries, and adapted for China by Xiao et al. (2013). As further modified here, it presents five types of technology strategy for ‘latecomer firms’ in developing economies that vary in their ambition as well as in their potential for developing innovation capabilities. This stream begs a question: what determines the choice of, and likely success in, technology strategy? A second stream, on ownership, governance and finance, has been shown by Tylecote (2007) to provide the elements of an answer. The framework developed there has been adapted for China (Cai and Tylecote, 2008; Xiao et al., 2013). But it remains limited in scope—focusing on the level of the firm and omitting key features even there. Our third stream, business systems theory, is broad (Whitley, 1999). It deals with relations among firms, showing how ‘alliance coordination’ makes possible what they could not achieve alone. It looks at employment policies and work management practices, and shows how they are affected by culture and how they constrain strategy (Whitley, 1999). And it deals with the role of the state, which in developing economies is of particular importance. The state’s positive and activist role is encapsulated in the concept of the ‘active developmental’ state (Whitley, 2007)—which is certainly relevant to China; but so is the negative role of the ‘extractive’ state (Acemoglu and Robinson, 2012). A state controlled by a Communist Party will certainly own key parts of industry, as well as most of the financial system; which helps to explain the key explanatory variables in the second stream.

In Section 2 we suggest how different technology strategies that are available for latecomer firms in developing countries are directly conditioned by firms’ *work*

*management practices, governance, and alliance coordination.* Together these constitute distinctive types of firms that are associated with particular kinds of technology strategies: in developing countries the predominant ones are *patriarchal* and *bureaucratic*, whose technology strategies tend to be the least ambitious. Section 3 examines the fundamental institutions of China and changing government policies in the reform period, to show how different types of firm and work management have become established in China. Section 4 describes China's existing business systems and their implications for firms' innovative capabilities, with illustrative case studies of the development of technology strategies in three Chinese firms representing different kinds of business system. Section 5 concludes.

## THE THEORETICAL FRAMEWORK

### Technology Strategies for Latecomer Firms in Developing Economies

Table 13.1 sets out five types of technology strategy for 'latecomer firms' in developing economies, in ascending order of ambition.<sup>1</sup> *Domestic imitative* strategy is least in ambition, but most in total impact: the more advanced firms in the country will be copied by others, particularly by firms in the same industry. The obvious means of imitation are reverse engineering and hiring ('poaching') key employees. One can also find out who supplied components and capital goods to the leaders, and buy from them. *Dependent* strategy is even easier, in principle: a latecomer firm gets a leading foreign firm to provide all the licenses, blueprints, key components, training, etc., necessary to manufacture a particular product (cf. Volkswagen and Shanghai Automotive with the Santana in the 1990s—Liu and Tylecote, 2009). The foreign firm is paid directly, or through a joint venture.

But the latecomer firm may not wish to pay, or to be dependent; or there may be no willing 'foreign frontier firm' (FFF). Then the alternative is an *international imitative* strategy—more difficult than the domestic variety, because the gap will be wider, and 'poaching' will be harder. Reverse engineering may be combined with own development projects: work out how the thing must have been made and then how to do it that way. Again, component and capital goods suppliers should be helpful, particularly if they are domestic and advanced (not a common combination). So should actual or prospective customers. Strategy is 'international imitative' even when the latecomer firm pays for licenses, consultancy etc., so long as the technologies are *unbundled*—each element is acquired separately, so that the latecomer firm has to make the effort of bringing them together—'systems integration', and has the opportunity and incentive to reduce its dependence step by step, while increasing its own innovative capability.

All these strategies may be obstructed by patents—and IPR (intellectual property rights) laws have been tightened up, first in developed countries, then (from the 1990s) in most developing economies, including China. Dependent strategies

<sup>1</sup> This typology originates from Freeman (1995) via Xiao et al. (2013), with Domestic Imitative Strategy added.

Table 13.1. Technology strategy and capability matrix

	Domestic Imitative Strategy	Dependent Strategy	International Imitative Strategy	Defensive Strategy	Offensive Strategy
<b>Nature of technology strategy</b>	Reactive—to stronger domestic firms: acquire tech by reverse engineering and ‘poaching’ employees	Passive—typically buy/rent a bundle of technologies from single FFF	Reactive—to strong foreign firms: follow by reverse eng’ing, unbundled licensing, selective development	Active—lead in engineering, product design, or process innovation; strong R&D	Proactive—be leaders in new products, thro’ own R&D and/or links with science base
<b>Potential for enhancing static capability</b>	Limited by low level being imitated; increasing IPR constraints	Limited by FFF co-operation	Slow to achieve; limited by IPR	High	High
<b>Potential for learning and requirement for dynamic capability</b>	Moderate; low	Low; low	High; medium	High; high	Very high; very high

Source: Adapted from Xiao, Tylecote and Liu 2013, Table 1.

should be least problematic, because the patent-holder is being paid for its co-operation. IPR will be more constraining, however, in higher technology sectors. Resistance to the international transfer of technology—bundled or unbundled—will increase as the latecomer firm approaches the frontier: it will be seen increasingly as a dangerous rival; and more will be patent-protected. It must then switch from either international imitative or dependent strategy to *one which will allow it to get its own IPR: a defensive strategy*. The minimum ‘defensive’ ploy is ‘inventing round’: find out what an existing frontier technology does, then find a slightly different, patentable way of doing it. Happily, ‘inventing round’ can yield improvements on the original, and later in the development process there will be opportunities to excel in production engineering. A strong defensive strategy should yield enough own patents to get a ‘seat at the table’ for cross-licensing. That will require heavy and well-directed spending on R&D, particularly development (and design).

The most ambitious innovation strategy is a successful *offensive* one that makes a substantial, deliberate, advance on the existing world frontier. That usually requires strong R&D well linked with the science base, as well as to leading firms in related sectors, lead customers etc . . . as appropriate to the sector.

In a developing economy as strong as mainland China, a domestic imitation strategy is too common to provide much competitive advantage. On the other hand, even in China a successful offensive strategy still remains very rare. So, although we shall look at one phase of an attempted offensive strategy, the other three technology strategies must be our main focus of interest. As we have seen, two of them are in a sense rivals: in the *early stages* of catch-up, after it has exhausted the possibilities of *domestic imitative*, a firm must choose between

*dependent*, and *international imitative*, strategies. Here we take it as given that international imitative is superior, because it develops greater dynamic capabilities (Liu and Tylecote, 2009). There is however no reason why a latecomer should not begin with an element of bundled technology, to get production experience quickly, before putting the emphasis on international imitation—as most of the Korean *chaebol* appear to have done (Xiao et al., 2013).

In this paper we shall be concerned to explain what characteristics and circumstances of firms determine their choice of strategies and their relative success. In the rest of this section we shall sketch answers a priori, and summarize them in Table 13.3. We shall distinguish among a number of firm types, and show how their governance and work management characteristics make them likely to choose and/or succeed at, certain strategies; and then consider what forms of alliance coordination may be associated with the different types and are needed by the different strategies.

### Governance, Work Management and Alliance Coordination: Their Role in Latecomer Technology Strategy

#### a) Governance and work systems

##### Private firms

Whitley (1999) has set out three types of firm which clearly suit the situation of private enterprise in developing countries in general and mainland China in particular: *patriarchal/opportunist*, *artisanal* and *paternalist*. All of them would normally be subject to *direct owner* control—the simplest form of governance (the other two being *committed owner* and *market* control (Whitley, 1999)) and to paternalist, personalized, authority (better accepted than formal authority—Child and Warner, 2003). Paternalist authority can be remote (the patriarchal firm) or reciprocal (the paternalist and artisanal firm types). *Artisanal* traditionally denotes a self-employed craft worker: artisans are proud of their skills and the quality of their products. An artisanal firm in effect brings a number of artisans together. Task fragmentation is low: there are simple general-purpose tools, so one worker is free to take responsibility for a range of operations—and has the skills required. Workers retain high discretion and involvement, and share control of work organization with the manager. Neither of these types is scalable above SME—patriarchal, because the boss must control everything; artisanal, because it too lacks explicit control structures.

A likely origin for a paternalist firm is an artisanal firm which succeeded and grew, as we show in the case of Delixi. If the artisanal firm grows, it may increase its productivity by investing in machinery, with more division of labour and task fragmentation. Work organization then must be tightened, with more explicit rules and clearer structures. But it can best pursue a fast domestic imitation strategy if it treats its skilled workers as a valuable asset able to learn for and with the firm. Substantial worker discretion and involvement will then continue. And the ambitious skilled worker now finds scope to rise within the new managerial hierarchy. It has now become a paternalist firm, with paternalist work management, as shown in Table 13.2, and illustrated by Delixi up to 2007.

**Table 13.2.** Principal work management types and the firm types to which they correspond in China

	Patriarchal (Opportunist Firms)	Artisanal (Artisanal Firms)	Paternalist (Paternalist, State-Paternalist Firms)	Socialist (Socialist Firms)	Taylorist (Bureaucratic Firms, Isolated Hierarchies)
<b>Task fragmentation</b>	Variable	Low	Limited	Limited	High
<b>Worker discretion and involvement</b>	Low	High	Considerable	Considerable	Low
<b>Manager control of work organization</b>	High	Shared	High	Shared	High
<b>Nature of managerial authority</b>	High discretion—‘arbitrary’	Personal, collegial	Charismatic (more for paternalist), somewhat rule-based (more for state-paternalist)	Collegial, somewhat rule-based	Formal, highly rule-based
<b>Organizational careers</b>	Limited and at owner’s whim	Limited	Include skilled workers	Include skilled workers	Limited to managers
<b>Rewards tied to</b>	Personal evaluation	Skills and personal evaluation	Individual performance and commitment	Linked to collective performance in key tasks	Standard jobs

Source: Adapted from Whitley 1999, pp.47–64.

But China is changing rapidly, and one can say modernizing—which is normally defined, there as elsewhere, as becoming more American. The archetypical American firm is what Whitley defines as an *isolated hierarchy*: an organization in which authority is formal not personal and whose external and internal relationships are contractual. Work management in an isolated hierarchy is more-or-less Taylorist (Table 13.2), with high task fragmentation and accordingly a clear distinction between a tightly-controlled majority of employees and a managerial elite which exercises control in a rule-based way (Whitley, 1999). By moving towards this type a Chinese firm may be able to take foreign investors on board, but as it loses personalized authority it may lose workforce commitment too.

We may now identify the technology strategies open to the different types. (See Table 3.) Being small and under-capitalized, neither *patriarchal/opportunist* nor *artisanal* firms can aspire to more than domestic imitative strategy, since that makes the least demands on finance and other resources and competences. The *paternalist* type is scalable, so other strategies are open to it, in principle. However

Table 13.3. Technology strategies and institutional requirements

	Domestic Imitative Strategy (ImD)	Dependent Strategy (Dep)	International Imitative Strategy (ImI)	Defensive Strategy (Def)	Offensive Strategy (Off)
<b>Governance characteristics and financing needs</b>	Direct owner control is typical. Minimal capital is required	Disengaged shareholders are typical. Good access to finance is required	Engaged shareholders needed. Self-financing <i>may</i> provide enough capital	Engaged and expert shareholders needed. Good access to finance is required	Expert and engaged shareholders needed. Good access to finance required
<b>Work management characteristics</b>	Patriarchal work management is typical; artisanal also possible	Broadly Taylorist WM is appropriate	Paternalist or socialist WM is appropriate	Paternalist WS may be adequate; socialist should be	Paternalist WS probably not adequate
<b>Alliance coordination</b>	Unnecessary and unlikely	Unnecessary and unlikely: fully-contractual relationship with FFF	Extremely helpful, domestically and internationally	Helpful, domestically and internationally	Helpful, internationally and domestically

in any developing country, few private firms are likely to have access to the resources required to make a success of dependent or (still less) defensive, least of all offensive strategy. This leaves international imitative strategy as, for most private firms, the only ‘ambitious’ option. This strategy is challenging, and one challenge is to governance: the main shareholders will have to be highly *engaged* in order to appreciate and support the diverse and often small-scale efforts needed to master an unbundled collection of techniques and technologies. And because the imitation process is fragmented and largely small-scale, much initiative and effort may be required from lower managers and skilled workers, so they should be committed to the firm.

What if a paternalist private firm is some way to ‘morphing’ into an isolated hierarchy? That will presumably involve getting a stock market listing—part of the formalization of structures and relationships which differentiates such a type from straightforward paternalism. Then further strategic options begin to open, because it can more easily raise external capital. This may make governance more complex, but new shareholders (particular foreign ones) may have the industrial expertise required to guide the firm in the difficult choices which must be made in a defensive strategy—which is not simply following a well-trodden path, but having to ‘pick winners’ near the technology frontier (Xiao et al., 2013).

### State-owned firms

Here we shall present our own typology. For any large state-owned firm in a developing economy, the obvious type is the *bureaucratic* firm: one which in effect operates as an extension of the bureaucracy—and probably a very top-down bureaucracy, given the high power distance (Hofstede, 2001) of most national cultures in developing

countries. Its top managers are officials, or treated as such. As such, their authority is formal and rule-based, not personal. Taylorist work management is clearly well suited for such structures, focused on formal systems of control.

The governance of such firms is problematic. In agency theory terms, there is normally no principal who will discipline the agent (top managers) in the interests of the long-term success of the business—only monitoring officials who usually have little time, interest or expertise. A dependent strategy is ideal for such firms, since its main requirements are good access to finance, and bargaining power. The monitoring officials can probably provide both: get cheap loans from state banks; and tell FFFs looking for market opportunities in the country that they will be blocked unless they set up joint ventures with favoured firms.

The international imitative strategy requires engaged shareholders (or monitors), which the bureaucratic firm lacks. The monitoring officials will not appreciate its slow and initially humble results—nothing to compare with the shiny equipment and high-specification products obtainable by a dependent strategy (Xiao et al., 2013). It also requires, as we have pointed out, initiative and commitment from shop-floor workers, rather than the mere obedience of Taylorist work management. The early stages of a defensive strategy, too, may produce nothing to impress a monitor: it will take time to build a position. And the monitoring officials will lack the industrial expertise that it requires.

Happily for China, it has produced other types of state-owned firm, which are capable of success in international imitative and defensive strategies. They are however much more ‘special cases’ arising out of Chinese circumstances, and accordingly we shall present them later, after sketching the context in which they developed.

### *b) Alliance coordination*

Work must be coordinated within firms, but also among them, and not necessarily through formal contracts (Richardson, 1972). Where inter-firm relationships are closer and more trusting than that, we can speak of ‘alliance coordination’ (Whitley, 2000). Assembled products such as motor vehicles and IT hardware typically require the coordination of many production operations which are entirely separable and diverse in character: it is generally thought undesirable to do this within a very large vertically-integrated firm (as it once was in GM and Ford) and that economies with well-developed modes of alliance coordination (like Japan and Germany) have an advantage in such sectors (Tylecote and Visintin, 2008).

Alliance coordination is of particular significance for latecomer firms making assembled products. As they catch-up they have to learn and change quickly in a way which is to some extent coordinated across the processes of production of all the components, sub-systems and final products. If they are catching up within a dependent strategy this is quite easy, because the FFF providing the technology can define the milestones of change clearly in advance. If the strategy is international imitative, on the other hand, and the assembling firm is buying in many of its components and sub-systems from domestic suppliers (as such a strategy demands), then *their* learning and change has to be coordinated: a challenge to the relationships among them and with the assembler.

The nature of the firm, as defined by governance and work system, does not define its alliance coordination, though it may influence it. But we may define



*business systems* which are characterized by a particular degree and scope of alliance coordination—and perhaps also dominated by a specific type of firm. Thus Whitley (2000) has three business systems with strong alliance coordination: coordinated industrial districts, collaborative, and highly-coordinated. The first is of particular interest here because it is dominated by types of firm/work management—artisanal and paternalist—which are ‘available’ to developing countries.

## THE FAMILY AND THE STATE: FUNDAMENTAL INSTITUTIONS IN CHINA

### *The family reasserts itself*

The most fundamental institution in China is clearly the family: historically the main activities of society, including ‘... production, distribution, consumption, reproduction, socialization, co-residence, and transmission of property, were primarily organized along kinship lines’ (Thornton and Fricke, 1987: 748); and important forms of interaction or co-operation among unrelated individuals or groups were also governed by kinship through mutual connections, references and reputation control (Greif and Tabellini, 2010).

The dominant role of the family was interrupted in the late 1950s, through the confiscation of family businesses in the cities and the Commune movement in the rural areas—but for a mere twenty years. After 1978 private entrepreneurship returned. Unsurprisingly, private companies as before show the typical characteristics of family-dominated enterprises, though at first of course they were controlled by the founder (Guo, 2000, Table 1). The example of overseas Chinese enterprise shows how power would in time simply shift to the second and third generations (Whitley, 1992).

There are two key terms in Chinese which relate to kinship: *jiating*—immediate family—and *jiazu*—‘clan’. In Chinese tradition, still strong in the countryside, the clan is a patriarchal institution reflected by the surname. In modern urban China the strict *jiazu* rules count for less, and links within it are supplemented by close blood relationships through the female line, and relationships through marriage—for example with a brother-in-law. We shall include these within the term *kinship-based networks*.

### *The family comes (again) to dominate the state*

In China, the state is of course controlled by the CCP (Chinese Communist Party). In such a huge organization much career advantage must go to those who can seek help and advice within networks of trust. Inevitably over time those networks have come to depend on the most enduring basis for trust—kinship. *De facto* control of the political (and economic) order in China in the mid-90s was already largely through kinship-based networks (Boisot and Child, 1996).

However, in the CCP each kinship-based network must fit into a larger one, the *paixi*, or faction, led by a patriarch with power at the top level of the party

hierarchy. Links within each paixi are made through ‘female’ blood relationships and marriage, study, work and ‘brokered’ connections (Wedel, 2009). As with family control of private business, this melding of family and state is a return to an equilibrium interrupted by Maoism, but being completely at variance with Marxist-Leninist ideology, it has proceeded without public discussion (FT.com, 2012).<sup>2</sup> We discuss its impact on business below.

### Developments in the Radical Reform Period (to 1989)

As of 1978, China’s major urban state-owned enterprises (SOEs) operated within a ‘command’ economy. But unlike the USSR, this system had only ever been applied to a small minority of goods and services (Whitaker et al., this volume). Most low-tech goods and services were *de facto* allocated by the market—or within enterprises and communes. Thus when after 1979 the country people were given ‘the power to make money’, the new rural entrepreneurs not only remembered private enterprise from the 1950s, but had up-to-date knowledge of some sort of market economy.

Through the 1980s there were then essentially two business systems in China: that of the urban SOEs, slowly being exposed to market disciplines, and the rural entrepreneurs, operating squarely within the market.<sup>3</sup> The rural focus of reform made it organizationally easy, but it remained highly controversial politically. The rural boom had profound and mostly uncomfortable effects on urban SOEs and their workers: it began to create competition for them, while by increasing aggregate demand it stimulated inflation. Opposition to reform on political grounds thus combined with urban opposition on grounds of self-interest. A conservative party faction around Jiang Zemin, appropriately Party Secretary of Shanghai, the largest city, opposed the reformist leaders led by Zhao Ziyang. The events of spring and early summer 1989 brought down the reformists and put Jiang Zemin in power, as CCP General Secretary (Huang, 2008).

Jiang immediately moved against the rural reforms. The local officials were encouraged to take over or otherwise prey upon the rural enterprises, which duly withered. A new paradigm developed for the rural areas: they would mainly provide agricultural products and migrant labour (Li Peng, 1996)—controlled within the *hukou* system which would continue to prevent them and their children from becoming city residents. (Huang, 2008).

### *The conservatives in power (from 1989)*

Between 1989 and 1992, the reform process simply stopped, having been rolled back in the countryside. Deng through his Southern Tour in 1992 managed to get it re-started, ‘in the face of stiff conservative resistance’ (Economist, 2014). The ‘resisters’, led by Jiang Zemin, were in charge of the process from now on: and it

<sup>2</sup> These links become apparent in corruption scandals, such as that of Lin Zhengce, denounced by the official Xinhua News Agency, referring to cadres who ‘use blood ties and marriage as a link to form a “clan of corruption,” to protect one another.’ (Lam 2014).

<sup>3</sup> Huang (2008) emphasizes its vigour and private ownership.

showed. Economic and political power would stay very close indeed, and in the same hands: the hands of the same *paixi*. The more high-tech and capital-intensive parts of the urban economy would stay under state control, and the *most* high-tech and capital-intensive, directly under the *central* state. The Organization Department of the CCP would continue to choose the top managers of these firms, who would continue to be senior officials. Matters would be arranged for the central state firms to have every opportunity to make money—profits—and by a decision of the State Council in 1994, these profits stayed with the firm—no dividends need be paid to the state.<sup>4</sup>

From 1992 a new dichotomy of business systems developed: higher-tech in the hands of slowly-reforming SOEs, lower-tech left to the private sector.

### Private Sector

The private sector firms were mainly:

- i. New foundations in the urban areas and in particular the rapidly-extending Special Economic Zones.
- ii. ‘Survivors’ from the rural boom—particularly numerous and vigorous in coastal provinces such as Zhejiang and Guangdong, which had direct access to export markets and relatively few SOEs.
- iii. Small and medium ex-SOEs, which were gradually privatized: ‘grasp the big, let go of the small’.

As we saw above, there were three types of firm for a private entrepreneur to choose among: patriarchal/opportunist, artisanal and paternalist—in ascending order of capacity for growth and innovation. Unfortunately the normal situation of the private firm has been precarious, with:

- Poor access to capital—bank loans being largely reserved for SOEs.
- Vulnerability to official interference.
- A workforce mostly made up of rural migrants, with little education and no rights.

There was little incentive or scope, then, to invest in equipment or skills, so the default model was the patriarchal/opportunist one.

The paternalist type, as we have seen, implies a degree of mechanization and relatively high capital intensity, and is scalable. It thrives on charismatic leadership and mutual commitment of leader and led—both compatible with Chinese culture, so long as the leader enjoys enough security to deliver on his commitments. That security may be based on good relationships with local government—which is most likely with privatized firms, since without such links the entrepreneur(s) would not have got control of the firm.

<sup>4</sup> The Decision of the State Council on Implementing the Tax Division Management System, which stated that SOEs need to submit taxes, but not profits. In December 2008, the MOF and SASAC announced that between 10% and 0% of profits must be handed over (Mattlin 2009).

## State-Owned Enterprises

The SOEs became differentiated, too, largely by sector—and by size. As the reform process developed, many SOEs were taken from central ministerial control and assigned to provincial or lower levels of government, according to size and sensitivity. Smallish SOEs that in a flourishing coastal province would have been privatized, in inland provinces with few job opportunities were generally kept under state control—so that they would not be forced to close down or at least shed labour. Since then, sub-central government has been entrepreneurial, setting up new firms and diversifying existing ones.

SOEs too, under conservative reform, have a default mode: the bureaucratic type of firm, which as we have seen maximizes control. Not only are the top managers of such firms, in China, senior officials, but they have the typical bureaucrat's career pattern: which means they move on to another quite different job after perhaps five years. This reduces their commitment to any firm, but increases it to the party—and the *paixi*. 'Maximize control' indeed extended right through the firm. The conservatives inherited an excellent work management process for this: Taylorism. The USSR had learned this from the USA in the 1930s, and taught it to China in the 1950s as *the* way to manage. It remained dominant, though as we see below not without counter-currents (Feng, 2010).

Given their emphasis on top-down control, and the absence of dividend payments, bureaucratic SOEs can be highly effective vehicles for rent extraction. How to make large profits from which to extract rents? First, lend the SOE whatever funds it needs for investment, at low or negative real rates of interest; second, exclude or disfavour private, foreign or sub-central state enterprises; third, ensure that central SOEs in the industry do not compete with one another.

There thus grew up the concept of the 'strategic sector', to be reserved to central SOEs. The overt reason for designating a sector as 'strategic' had to be its importance for China's future development. But the ideal covert reasons were that it was naturally large-scale, capital-intensive and catered to the home market. If its firms were bureaucratic SOEs, a kinship-based network, with help from its *paixi*, could then control the sector comfortably, by controlling senior appointments. As of 2006, the seven 'Strategic and Key Industries' were: Defence, power generation and distribution, telecoms, oil and petrochemical, coal, civil aviation, shipping. The stated aim was to maintain 100 per cent state ownership or absolute control; there were about 40 central SOEs in them. A second tier, Basic and Pillar Industries, comprises: Machinery, auto, IT, construction, steel, base metals, chemicals, land surveying, R&D. Here the aim is to 'enhance the influence of state ownership even as the ownership share is reduced where appropriate' (60 central SOEs—Mattlin, 2009: 13).<sup>5</sup>

'The central enterprises have more than 17,000 subsidiaries, often on as much as five different hierarchical levels. Many productive assets are actually in private or partially privatized subsidiaries.' (Mattlin, 2009: 14). Convenient for rent

<sup>5</sup> These sectoral labels should not be taken literally. Thus the central government is not interested in dominating telecoms *manufacturing*, an unavoidably, uncomfortably competitive industry—just telecoms services, which isn't.

extraction.<sup>6</sup> The rents are certainly there to extract: more than 90 per cent of the net profits of the entire state-owned sector in 2005 went to central enterprises (RMB 627.7 billion): of this figure, the profits of the 12 most profitable firms accounted for 78.8 per cent (Mattlin, 2009).

Such firms could not be or become genuinely innovative: they would be limited to ‘dependent’ technology strategy. And yet China needed real innovation—international imitation at least, in the first instance—and had done from the beginning of CCP rule. Dependent strategy, with Taylorism, would not work in the defence industries, because even the Soviet ‘big brother’ before the 1958 split, would not transfer advanced military competences and secrets. The ‘two bombs, one satellite’ programme which gave China nuclear weapons and the capability to deliver them, depended on Chinese emigrants who had learned innovation-friendly work management in the USA (Xiao et al., 2013). Moreover it had been discovered in the 1950s that Taylorism did not always work well even where Soviet technology was available. The Angang steel plant became the foremost exponent of a more ‘bottom-up’ style of management, suitable where some creative adaptation was required (Feng, 2010).

Accordingly there developed a second type of state enterprise, the *socialist* firm (Xiao et al., 2013). A key managerial role in such firms is played by ‘red experts’: *you hong you zhuan*, technologically expert, red in political commitment. The firm is led by red experts, who normally have worked in the firm for a long period, perhaps their whole career. We expect to find such firms in defence industries, and defence-related ones (see next section): industries where it is a state priority to master advanced technology, and where little assistance from abroad is to be expected; where rent extraction cannot be a priority. Their work management is quite different from the bureaucratic type: like the paternalist firm, it has limited task fragmentation and skilled workers have considerable discretion and opportunity for organizational careers; like the artisanal firm, control of work organization is shared with workers; unlike any other type, authority is collegial and somewhat rule-based, and rewards are quite strongly linked to collective performance in key tasks (Table 13.2).

Neither the bureaucratic nor the socialist model matches the requirements of most sub-central governments. Their firms are usually less privileged—rarely given market power such as central SOEs enjoy in strategic sectors and some others. Sub-central firms must ‘earn their own living’, then, to a much greater extent. And senior sub-central government officials need their firms to succeed—for their own performance is evaluated largely in terms of income per head and employment. So, to paraphrase Deng, which sort of cat would catch the mice? The paternalistic firm. How could an SOE approximate to it? Find one or more able, youngish and preferably charismatic individuals, inside or outside the firm, and make it clear to them that if they ran it well, they would stay in charge, and share in its success. The arrangement might be formalized, as with the four

<sup>6</sup> Now that Zhou Yongkang and Bo Xilai are disgraced, some of their paixi’s rent extraction has been exposed. CNPC, China’s largest oil company, has been apparently a hive of subcontracts, ‘most of them not publicly revealed, with companies belonging to former regional bosses, local government officials or powerful families in the ruling Communist party’, all associated with the Zhou faction (FT.com April 22, 2014).

‘founder managers’ of ZTE<sup>7</sup>, or left informal, as apparently in GTC (Liu and Tylecote, 2009). In China, anyway, formality gives less security than good relationships. By now it is uncontroversial to let top managers have substantial shareholdings. There are many minority-state-owned enterprises (MiSOEs) in which top managers are not selected ‘administratively’, but by the shareholders (Cai and Tylecote, 2008). The sub-central government shareholding protects their position. This then is the *state/paternalist* firm—with work management much like the paternalist, except that managerial authority is more rule-based.

BUSINESS SYSTEMS AND INNOVATIVE CAPABILITY:  
 TYPES AND EXAMPLES

In this section we examine the innovation patterns of the dominant business systems in China, and illustrate them through three firm-level case studies. Material for these case studies was gathered from published journal articles, secondary statistics, government documents, and interviews conducted by one of the authors between 2008 and 2014.

Table 13.4 gives a typology of business systems, with the reservation that it originally referred to economies not including mainland China, and that a 2x2 matrix always over-simplifies. We can say that without either ownership coordination or alliance coordination, firms in a business system can scarcely develop the capabilities necessary for any real innovation. By definition, strong ownership coordination is only possible in a large firm, and so business systems dominated by small firms must be in the north-west or south-west quadrants; the latter having the possibility for innovation. We discuss them further in 4.1, where we present our first case, on Delixi.

Business systems dominated by large firms might be in the NE or SE quadrant. Strategic sectors dominated by bureaucratic firms might be coordinated by a *paixi*, but this could be to avoid competition; we are unaware of any cases of more

Table 13.4. Six types of business systems

		Ownership coordination	
		Low	High
Alliance coordination	Low	Fragmented	Compartmentalized Conglomerate
	Medium to high	Coordinated Industrial Districts	Collaborative Highly coordinated

Source: Adapted from Whitley (2007, p.13)

<sup>7</sup> Hou Weigui, the founding CEO of ZTE, was still in control, latterly as chairman, after more than 20 years. In five of the largest six Chinese electronics/electrical firms—Lenovo, Haier, BOE, Huawei and Midea—the founding CEOs were still in charge in 2006 after an average of 22 years (Tylecote, Cai and Liu 2010).

positive alliance coordination. Other sectors have a mix of POEs and SOEs<sup>8,9</sup>. SOEs do not ‘do’ strong alliance coordination in China because this implies and requires lower-level initiative—independent of the state (White, 2000). The emphasis in post-1992 China is on vertical ties, not horizontal ones<sup>10</sup>. So there is nothing resembling the ‘collaborative’ systems of North-Central Europe, in which alliance coordination is very strong within the sector, or the ‘highly-coordinated’ business system of Japan, in which it extends across sectors. For China, the SE quadrant is empty.

What remains is the NE quadrant, where coordination is achieved within large firms. This can be across sectors—as with the *chaebol* conglomerates of South Korea—or within sectors, as with ‘isolated hierarchies’, the classic large firms of the US and UK. Again, mainland China does not ‘do’ cross-sectoral coordination within large firms. The vertical control structure within government is sector-specific, particularly at central level, and so it could not cope with a large SOE spanning several sectors. There are many SOE ‘industrial groups’ in mainland China, but they are not diversified substantially across sectors (Lee and Woo, 2001). Private firms are rarely so large, and would never be allowed the industrial power exercised by *chaebol*. Large Chinese firms then operate within ‘compartmentalized’ business systems: the classic Anglo-American model, which makes it the more attractive for Chinese emulation.

We can now indicate and explain our choice of cases. In 4.2 and 4.3 we shall examine two firms operating within compartmentalized systems—Midea, a large POE (privatized in 1981) and CNEGC, a ‘socialist’ *central* SOE. They are very different in firm type; they appear to be unusually innovative; and they gave us good access. (For lack of space, we have left out the third main ownership type, the sub-central SOE, which can be innovative when managed in ‘state-paternalist’ style. Happily there is an abundance of case studies on this type: GTC and Chery in Liu and Tylecote, 2009, ZTE, Haier, Hisense in Kwak, Lee and Chung, 2012, Williamson and Yin, 2013). Our first case, Delixi, is chosen to extend our range as far as possible: it is a POE of different—artisanal—origins to Midea, and it operates within an industrial district.

### Industrial Districts: More and Less Coordinated

The term ‘industrial district’ simply denotes an area with a high degree of specialization in one sector, and a large number of firms in that sector. Mainland China certainly has many of those. Some of these are formed around a large SOE: for example Shiyuan National Auto Parts Manufacturing and Trading Centre in

<sup>8</sup> The ‘defence’ sector may be a special case, because dependent technology strategy is not generally open to the firms in it. Anyhow the case of CNEGC in 4.3 takes us quite close.

<sup>9</sup> It will be noted that we define and differentiate business systems by sector, on the grounds that both competition and coordination take place very largely within sectors; whereas Whitaker et al. (this volume) distinguish them rather by region. There is no fundamental inconsistency.

<sup>10</sup> Or to put it another way, ‘with its strong and extensive role of the state, the dirigistic system reduces the likelihood of inter-firm co-operation by aggravating vertically-ordered and unequal power structures, weakening the ability of firms to organize collection action and limiting the density of intra-system connections’ (Zhang, this volume, p.11).

Hubei province was gradually formed around Second Auto Works, one of the ‘Big Three’ auto-makers (Fan and Scott, 2003). Others cluster through government initiatives such as ‘industrial development zones’ or ‘high- and new-technology zones’ such as the Shanghai Zhangjiang high- and new-tech district (Lai and Shyu, 2005). But the best-known, in provinces like Guangdong and Zhejiang, seem to have grown up organically: a business somewhere succeeds with product X—socks, or ties, say—and before long some of its original employees have set up in competition with it, or been poached by rivals, and some of the rest have set up as suppliers to it—and its rivals (Fan and Scott, 2003).

What then is a *coordinated* industrial district? The modern paradigm cases of coordinated industrial districts are from the ‘Third Italy’, which has both decentralized political structures and the social cohesion required to make them work. As such, much of the coordination comes directly or indirectly from local government—from local public-sector banks, for example, or from technical colleges which teach what workers in the industry will need to know (Crouch et al., 2004, Part 1). Chinese local government does indeed wish to help local industry, as we have seen, but ultimately it represents Beijing, and that constrains what it can do and how well it does it (see Zhang, this volume). The focus must then be on voluntary relationships among firms, probably all POEs, operating in a traditional Chinese way based on a combination of proximity and kinship ties. As all China knows, there is one region which excels in networked private enterprise: Wenzhou, in Zhejiang province. For our first case, we have therefore chosen the key firm in an industrial district in Wenzhou—one operating in a medium-high technology sector.<sup>11</sup>

## Delixi

Established in Wenzhou in 1984, Delixi Group (Delixi) is now one of the 100 largest Chinese POEs. It specializes in manufacturing electric power transmission equipment: that is, a medium-high-tech product whose technology is not advancing very fast. Delixi is a family-controlled POE: its founder Hu Chengzhong is chairman, while his brother is CEO.

### *Phase 1: Domestic Imitative strategy (1986–1990)*

Delixi had a typical artisanal origin—a back-yard workshop called QJ Electrical founded by friends and relatives with little technology and very little finance—yet the most dynamic kind: that is, with strong entrepreneurial leadership and in a region with a highly entrepreneurial culture and relatively high trust among local entrepreneurs. The ambition was bold: to overtake the then domestic leader Shanghai People’s Electrical Factory (ShPEF), an SOE. In 1986 Hu poached ShPEF’s senior engineer to be technical consultant and borrowed from

<sup>11</sup> Here, we did not have access for primary data. We began with Williamson and Yin’s (2013) case study and augmented it greatly from secondary sources such as websites, news reports, blog posts, professional magazines, promotional material, biography, etc. Triangulation was also conducted by including factual information from independent sources and material composed by key competitors. (n =53)



loan sharks to finance the first corporate thermal relay testing laboratory outside Shanghai. By 1990 QJ's revenue surpassed ShPEF and its reputation for quality and reliability had become well established. The firm split, in 1991, into Delixi and Zheng Tai: the development of Delixi appears to revolve around intense rivalry with Zheng Tai.<sup>12</sup>

### *Phase 2: International Imitative strategy (1990–2007)*

During Phase 2 Delixi moved quickly to an International Imitative strategy—having little to learn from any of its domestic rivals, apart from Zheng Tai. As it did so it appears to have become a classic Paternalist firm—of a particularly informal kind, due to its artisanal origins. It built up a closely coordinated supply chain of smaller local firms, often binding them even closer by taking minority stakes in them or joint ventures with them (Williamson and Yin, 2013). This minimized its need for capital—important, given the continuing difficulty of getting loans, as a private firm. Thus, through detailed internal and external division of labour, Delixi gained flexibility and price advantage over FFFs based on lower production cost; whereas rigorous testing routines and standard-setting gave superior quality over domestic competitors. It was developing a business model characterized by flexibility, speed to market, and mass customization (Williamson and Yin) (cf. Japanese electronics firms in Whitley, 1999).

Delixi's informality was expressed by its treatment of its employees. Delixi appears to have spent very little on training (even in 2012, only RMB750,000—Delixi website) and only 5 per cent of manufacturing workers have any form of certification.<sup>13</sup> But Delixi's work management incentivizes informal learning that extends to rank-and-file workers. When young female university graduates and rural migrant workers have undertaken extra training in their own time to improve technical expertise and skills, Delixi has recognized it by promoting them, sometimes to middle-management level (Yuan et al., 2014). This is unusual in China, where seniority and good relations with top managers are often essential for career progression (Chow, 2004). By its paternalist policy of recognizing and rewarding hard work, loyalty and informal learning and training, Delixi was able to benefit from workers' commitment and high skill level.

We can assume that all or most of these good things were being done by Zheng Tai too. In 1996 Delixi was the second largest domestic player in China, but it was just behind Zheng Tai (Sina Blog, 2011). This may perhaps account for Delixi's policy in the late 1990s of growth by acquisition of local SOEs and their production lines (Yuan et al., 2014).

From 2000 the rivalry between Delixi and Zheng Tai revolved increasingly around R&D. In that year Delixi became the first electrical POE in mainland China to set up an R&D lab employing post-doctoral staff (Yuan et al., 2014). We

<sup>12</sup> Porter (1990) stresses the value of local rivalry. This is partly motivational: *local* rivalry is the most intense, and success gives, in his words, 'bragging rights'; also there must be exchange of skills and competences, not intentionally but through movement of workers and 'careless words' in bars, etc.

<sup>13</sup> Chinese firms are reluctant to provide formal training, let alone certification to their employees due to high turnover rate (14.3% according to the Aon Hewitt survey. <http://aon.mediaroom.com/Chinese-Employees-Witness-Average-Salary-Increase-of-8-5-and-14-3-Turnover-in-2013>.)

can assume that Zheng Tai responded quickly: their response was certainly effective, to judge from the triangular relationship which developed between the two and their most direct FFF competitor, the French electrical multi-national corporation *Schneider*. Naturally, Schneider used the patent courts to hold off their competition both inside and outside China: but it appears to have sued Delixi only once, in 2005, and the suit was settled out of court. It sued Zheng Tai more than 20 times for intellectual property (IP) infringement between 1999 and 2007, three of which in European courts (China IP Magazine, 2008). Zheng Tai successfully defended all the European suits, and most of the Chinese ones; moreover it successfully sued Schneider once for infringement in China. By 2007, Zheng Tai was 38 per cent ahead of Delixi on turnover (China enterprise confederation website, top 500 Chinese manufacturers 2007 and 2013).

Thus Zheng Tai appears to have been moving more successfully towards a defensive strategy (perhaps due to Delixi's diversion of substantial capital into real estate speculation in the early 2000s) (China IP Magazine, 2008). As such it was for Schneider the more dangerous competitor—and potentially the more valuable collaborator. Three times Schneider offered Zheng Tai a deal to form a joint venture of some kind: the first time with 20 per cent of the equity for Zheng Tai, the third time 50 per cent. Three times Zheng Tai refused. Finally Schneider turned to Delixi, and in 2007 struck a deal. They set up a 50/50 joint venture, Delixi Electric, with all non-executive directors including the chairman appointed by Delixi, and the CEO appointed by Schneider. Delixi committed seven of its top-selling models as well as production operations to the JV; Schneider injected a substantial amount of cash. Although Delixi has five wholly-owned subsidiaries, Delixi Electric dwarfs them, both in terms of assets (*circa* 60 per cent of group total) and revenue (75 per cent) (21st Cent. Economic Report, 2007).

### *Phase 3: Defensive strategy (2007–)*

Now Delixi had the advantage over Zheng Tai, with access to Schneider IP and Schneider capital. Since 2007 Delixi has established an R&D centre in Germany and has filed over 100 patents in the European Patent Office. As of 2013 it had assets of RMB 5bn (US\$250 million), over 14,000 employees, 3 manufacturing bases, 3 R&D centres, 9 sales offices, 14 logistics centres, 30,000+ points of sale in China; and its export business covered 50+ countries. Its R&D has resulted in over 10 national standards (Delixi website, accessed October 2014).

Delixi is now free to expand and continue up-market with a defensive strategy, which it is doing, but 'it' is now a partly foreign firm, in no position to become the 'transformer Huawei': Schneider can both profit from its success and (perhaps) make sure it is not too successful in future. There is another probable effect of the deal: to make sure that *Zheng Tai* is not too successful in future, since Delixi can go head to head with it across its product range, with the decisive advantage of Schneider expertise and licenses (and cross-licenses). And indeed between 2007 and 2013, Zheng Tai's margin over Delixi in total output shrank from 38 per cent to 12.8 per cent (China enterprise confederation website, top 500 Chinese manufacturers 2007 and 2013). Recent comments by customers on a blog (Baidu Electrician's Forum, accessed in November 2014) suggest that Zheng Tai leads on quality, but is being undercut by Delixi on price.

Just as Delixi Electric is only a half-Chinese firm, it is unlikely to be managed as a paternalist one, since its CEO is, while Chinese, a long-serving Schneider executive and the Schneider Asia CEO.<sup>14</sup> It remains to be seen whether such a move towards an isolated hierarchy will suit current Chinese conditions.

### Innovative POEs: The Case of Microwave Ovens in Midea

Midea is China's second largest consumer electronics and white goods manufacturer. It is based in the Shunde region of Guangdong, China's biggest industrial district for home appliances, which hosts more than 2,000 manufacturers and suppliers of different ownership types, including Galanz and Kelon (POEs); Hisense, Gree (SOEs); and Bosch and Whirlpool (FFFs) (SdHAA website, accessed in November 2014). Midea has been the largest Shunde firm by assets and turnover since 2003. As of 2013 Midea Group had US\$19 billion turnover with six product divisions, over 150,000 employees and 30 subsidiaries worldwide. Midea is thus large, complex and old, and therefore the case study here is restricted to one type of product within one division, focusing on the last three or four years. During this period Midea's resources have been ample for a defensive strategy and have even opened the possibility of an offensive one: and that is what we found.

Founded by the local Shunde government in the 1960s, from 1981 Midea was gradually sold to the CEO, He Xiangjian. In 2001, He and his family bought out the local government's stake, and became the biggest shareholder (56.63 per cent). Between 2011 and 2012 two private equity partnerships, either central state-owned or central state-connected, bought into Midea Group and became the top two shareholders of tradable shares. Midea debuted on the Shenzhen Stock Exchange (SZSE) in September 2013. Yet at 33.56 per cent He is still by far the largest shareholder and in full control.

With more than 60 per cent female labour force working mostly on assembly lines (Midea, 2014), work management in Midea seems Taylorist.<sup>15</sup> With its SOE origins, age, and large size, authority in Midea is clearly more formal than in an artisanal start-up like Delixi. Unlike Delixi, a non-family CEO/Chairman succeeded He in 2012. This does appear to be a firm which is not far from being an isolated hierarchy. *Isolated* indeed: one striking difference from Delixi is the extent of vertical integration. Although surrounded by hundreds of potential suppliers, 'We do our best to bring everything in-house [through both green-field projects and acquisitions] . . . because it's easier to control one big firm that we own than dozens that we don't . . .' (Interview with chief operations officer, April 2014.)

There is very limited coordination with other big firms in the sector too. Initiated by Shunde government, Midea and other 11 local Chinese manufacturers

<sup>14</sup> 'Transnational companies . . . are particularly influential agents for the inward transfer of management practices, especially the use of formal provisions for governing joint venture behaviour and the adoption of foreign company cultural norms.' (Child and Warner 2003 p36).

<sup>15</sup> The author/interviewer checked off from personal observation the first three of the Taylorist characteristics mentioned in Table 2. Check list was also sent to, and verified by our informants at Midea (2014).

formed Shunde White Goods Association (SWGGA) in 2007. But the primary goal appeared to be to tap into the talent pool and research of five Chinese universities (SWGGA memorandum, 2007, 2009), rather than ally with each other. So far no real inter-firm collaboration has materialized, on training, sharing test facilities, or other R&D (according to a Chinese academic studying collaborations in Shunde, interview in November 2014).

The microwave business unit belongs to Midea’s kitchen appliance division, which has approximately 10,000 employees with turnover of US\$1.8 billion (2013). By 2003 Midea was established as the second largest manufacturer (after its Shunde rival Galanz) of microwave ovens in China with 40 per cent market share in 2013 (Midea, 2014). Starting with buying a Magnetron plant from Sanyo (Japan) in 2001, Midea brought the entire supply chain in-house (Midea, 2014). On the other hand it spends heavily on microwave technology. Its R&D rose from 2.56 per cent of the small appliance division’s turnover in 1999 to over 4 per cent in 2013 (Midea, 2014). It has led in introducing functional features that suit Asian cuisine requirements, such as water-less steaming. If we compare its patent portfolio in the field with those of its main rivals (Table 13.5), it would appear to be pursuing a defensive strategy.

Significantly, Midea seeks innovation in core technology. It claims that its microwave R&D centre, set up in 2006, is the most advanced in the country, hiring post-doctoral researchers—seen as a crucial marker of ambition in China. Since 2010, with a handful of FFFs, it is one of the first-movers towards a new trajectory of microwave technology. Through collaboration with Freescale Semiconductor, a Texas-based FFF and the (Chinese) University of Electronics Science and Technology (UESTC), Midea has been developing a new generation of microwave ovens using *solid state RF (radio frequency) transistors*. Compared to traditional microwave ovens using magnetrons, solid state RF technology offers gains in energy efficiency, safety, accuracy and product longevity (Tang et al., 2013). By 2013 Midea had received seven patents for this technology, including four invention patents from United States Patent and Trademark Office. In June 2012 it was exhibiting, in the US, a number of prototypes made with Freescale (Microwaves and RF, 2012).

This appears to be an offensive strategy for Midea, even though led by Freescale. Freescale provided the (general) solid state RF technology, transistor prototype and development system at a fee, whereas Midea conducted follow-up research on product implementation, control mechanism, user interface and heat solution (Midea, 2014). Meanwhile, Midea has been working with a number of Freescale’s rivals to improve the product and design. In the manner of Korean *chaebol* (Whitley, 1992) it has been financing the project with inter-divisional transfers (Midea, 2014). It is clear that Midea is strategically proactive and trying to leapfrog FFF rivals like Samsung.

**Table 13.5.** SIPO (Chinese) invention patents in microwave oven technology—Midea and main rivals, 1999–2013

	Midea	Galanz	Samsung	LG
<b>Patents granted</b>	23	20	199	94

Source: <http://epub.sipo.gov.cn/patentoutline.action>, accessed in November 2014

Offensive strategy is difficult: as of late 2014 Midea had failed to reach the standard for power output for the solid state RF ovens, and no launch date was set for commercialization. And in October 2014 it was announced that Freescale was bringing out two new solid state RF power transistor products and an application development ecosystem. ‘The additions are engineered to enable consumer and commercial microwave oven appliance original equipment manufacturers (OEMs) to create differentiated solutions and novel product types for a new cooking paradigm.’ (Business Wire, 2014) This implies that Midea’s privileged position vis-à-vis Freescale is at an end, as Freescale will now help later-comers to solid state RF to catch-up whatever lead Midea may have achieved.

What could have gone wrong here? The key challenge is to improve power output, the main unsatisfactory feature of product design and performance. In order to overcome it, R&D needs to be closely integrated with, and supported by production engineering (cf. German manufacturing, Tylecote and Visintin, 2008). Yet ‘production engineering’ was not mentioned once during the interviews at Midea; and neither the key researcher nor the project manager appeared to have any direct expertise in manufacturing or operating management. China’s deficiency in manufacturing engineering is notorious: POEs’ specialist units in manufacturing engineering are almost always small and weak, and line management have little knowledge of advanced process and product technology (Gong, 2014). Training spend is minimal: in Midea less than 0.04 per cent of turnover. Here we see the influence of absent alliance coordination: unlike German firms, Midea and its rivals do not co-operate to train up their best production operatives to be able to contribute to production engineering; and none of them alone can justify an expense which would benefit its rivals. They could hire graduate production engineers; but these are scarce, and central SOEs can pay better.

### Socialist Firms: The Case of CNEGC in Steel Plant

We argued in the last section that there is an innovative type of firm even among central SOEs: the *socialist* firm, which is to be found in defence-related industries. In fact our ‘socialist’ case study is of a manufacturer of heavy machinery, with a strong specialization in steel plant—steel being still regarded as a key material, particularly for national defence. But the US government does not regard it as such, so steel plant is not subject to the US COCOM restrictions on technology transfer, which, it has been argued (Gao, 2005), helped to develop a strong Chinese telecoms manufacturing industry, because they obstructed the ‘lazy’ dependent technology strategy. Steel plant manufacturers should be able to follow such a dependent strategy as freely as (for example) auto-makers. As we shall see, CNEGC did not do so.

The career patterns of successive CEOs confirm the ‘socialist’ character of the firm: all of them, back to the 1980s, had spent decades working in the firm: ‘red experts’, then, rather than bureaucrats. We can expect similar commitment of the workers to this firm, moreover: as a *central SOE* operating in a relatively poor province (Sichuan) its pay and conditions will be highly attractive compared to almost any conceivable alternative employment. By the same token, since employee turnover is very low, it can afford to train its workers well. They needed

to be well-trained, moreover: heavy machinery is not amenable to mass production and requires skilled manual workers to be directly involved in production (see Guillén, 1994). The firm thus was well matched to the ‘participative’ characteristics of ‘socialist’ work management mentioned in Table 13.2. To complete the picture of strong innovative capability, we may note that its main customers, steelmakers, are mostly central SOEs (CNEGC internal document). As such, there is no impediment to close co-operation with them—possibly leading to a degree of alliance coordination.

CNEGC’s precursor was founded in a heavy-industry cluster in Sichuan in 1958, and renamed CNEGC in 1993. It has the coveted status of ‘backbone’ enterprise: a ‘heavy machinery base’, one of 21, and as such is owned by the central state. Accordingly once the reform process began it was one of the very first firms to be allowed, and funded, to get foreign help—in 1979. It needed it: CNEGC found itself far behind the technological frontier across its product range. Its technology strategy during the 1980s can be described as international imitative rather than dependent. It set up no JVs and used three different FFFs to help advance its techniques of casting and forging: evidence of ‘unbundling’. Meanwhile it established two important R&D units, the Heavy Machinery R&D Unit and Large-size Casting and Forging Research Unit: good preparation for a move to defensive strategy. During this period it developed detailed design capability—ability to modify a general design to suit the specific requirements of a customer—and met international standards in many of its manufacturing processes. Catch-up continued: during the 1990s it drew on eight foreign firms for product technology for steel plant alone: still imitation, but more advanced.

Unfortunately for CNEGC, by this time it was itself subject to domestic imitation, by recently-established private firms, which by undercutting its prices took most of the Chinese market for small and relatively simple items of plant, and cut its margins on what still sold. In more sophisticated equipment, CNEGC faced the ‘80:20 problem’: doing 80 per cent of the job but receiving only 20 per cent of the profit. The rest of the profit went to the FFFs: in royalties for technologies transferred, plus payment for core components that it did not yet make. A key challenge was CNEGC’s leading steel product, the *hot tandem mill*. The core component that it did not yet make, here, was the *hot coilbox*. If it could learn how to make it and get its own independent IP, it might become a one-stop contractor in hot tandem mills: provide a full service from product design, through manufacturing, to installation.

It turned out that the hot coilbox had been patented by FFFs in 69 countries—but not China. (To get a Chinese (SIPO) patent one must supply an unusual amount of detail, and the FFFs may have preferred not to give would-be imitators so much assistance.) CNEGC was thus free to reverse-engineer the coilbox—if they could. Two ‘red experts’ led the project: an experienced engineer, Mr Tang, was in direct charge, overseen by the deputy Chief Technology Officer. They learned by a long process of trial and error how to make the mandrel at the core of the box—its alloy composition, for example, and kept that secret. And they worked out their own design for the box, which they patented, in China: it matched Chinese steelmakers’ needs better than existing designs.

Unfortunately, the target meanwhile had moved: FFFs had brought out a new, improved type of *mandrelless* hot coilbox. So a mandrelless hot coilbox project

team was set up—led by Tang but organized by the newly-formed Technical Centre. A design was successfully produced, in 2001 and again patented in China; another new mandrelless design was patented in China in 2007. The hot coilboxes available on the international market had not suited the Chinese steel industry's particular conditions—long production lines, steep temperature gradient along the 'embryonic strip', and unstable quality—CNEGC's did, and it could make them for 30–40 per cent less than imported coilboxes. It gradually took over as one-stop contractor in this field. From 2000–2008, its hot rolling strip steel mills with patented hot coilbox technology earned it RMB6bn., some \$900mn. at 2008 exchange rates. It had established itself as a successful defensive innovator. It had done so because the governance characteristics of the 'socialist' type of firm, and the requirements of successful production in heavy machinery, led it towards participative work management and away from the dead end of dependent strategy. We surmise also that its status of central SOE made it better able to work closely on product innovation with its major customers, also central SOEs.

## CONCLUSION

In this chapter we have suggested how institutional change in China, from the late 1970s, shaped the evolution of business systems and the types of firms which composed them, which in turn helps us to understand the extent, location and nature of innovativeness in Chinese firms, recently and currently.

We described a 'conservative' reform process, dating from 1989–1992, which led to the dominance of two types of firm in mainland China: *patriarchal/opportunist* (dominant in numbers among POEs and thus in terms of total employment) and *bureaucratic* (dominant among central SOEs and thus in terms of resources available). Unfortunately, the nature of their governance and work management processes and their typical membership of *fragmented* and *cartellized business systems* respectively, limit their innovative capabilities.

Less common in the private sector are *paternalist* firms, able to function efficiently at large-scale and in principle to be genuinely innovative. Our first two case firms were, or at least had been, paternalist: the first, Delixi, of artisanal origin, the second, Midea, originally state-owned. Delixi's origins together with its location—the Chinese capitalist Mecca, Wenzhou—may explain its relatively strong alliance coordination with its suppliers within an industrial district. As time passes more regions will have POEs grown to produce more complex products, and for this they will have to develop more inter-firm trust, and thus build more-or-less coordinated industrial districts in the (non-strategic) sectors ignored by the central state. Midea's origins and location explain its lack of alliance coordination and its size. Its size, diversification and willingness to cross-subsidize are reminiscent of the Korean *chaebol*. Its new connections with the central state—through the private equity shareholders—also resemble the *chaebol*. But the main *chaebol* do not operate in a common labour market like Shunde, in which each firm may be reluctant, like Midea, to spend on training because the trained workers may then decamp to a rival. Midea is operating in a

business system which approximates to a compartmentalized one—all the more, as the firms in it approximate increasingly to isolated hierarchies.

Delixi and Midea had in common, a fierce rivalry with at least one local competitor; and a strong relationship with an important FFF. Delixi's FFF was a clear-cut competitor, Schneider, and the deal done with it jeopardized its independence. That was the price it paid for rescuing a failing defensive strategy and catching a local rival which had been succeeding in such a strategy. The net effect might be to prevent the emergence of either Delixi or its rival as a strong Chinese player in their field. This danger is typical for emerging economy firms in general—with the general application of TRIPS deals on IPR, their sales abroad and even at home are inhibited by FFFs' IP portfolios; and with the freeing of foreign direct investment (FDI), the FFFs are able to invest on their territory. A 50/50 joint venture may seem better than complete subordination.

Midea's FFF, Freescale, was more a core component supplier than a competitor—but it was the leading player in the biggest paradigm shift the microwave oven industry had seen. Midea pulled off a coup in winning Freescale as collaborator—a move towards offensive strategy after a successful decade in defensive mode. But as the industry adapted to solid state RF transistors as heat source there would be much destruction of competences and thus much need to build new ones and the IP portfolio to match. Emerging technologies have been seen as golden opportunities for latecomer firms to leapfrog rivals in advanced economies—as Korean ICT firms did Japanese, in the digitalization paradigm shift. But the same paradigm shift wiped out more than a decade of catch-up by Chinese TV firms and left them hopelessly dependent on FFF IP (Xiao et al., 2013). In adapting to the new transistors in microwaves, the integration of R&D with production would be a challenge. Lack of training undermines manufacturing—manufacturing firms in China repeatedly complain that they lack skilled people in production engineering (Gong, 2014). While progress was cumulative, Midea's informal on-the-job training would suffice: but now? Likewise Midea's largely Taylorist work management was a poor basis for success within the new paradigm. The Midea experience so far sends an alarming message to other latecomer firms: even if they have very largely caught up through international imitative then defensive strategy, they may still slide back in a new paradigm shift, if their domestic institutions do not support an offensive strategy, or even, particularly, a defensive one.

In the state sector, SOEs owned by sub-central government quite commonly exhibit a rather engaged style of governance and somewhat participative work management, which we call state-paternalist, and we referred to a number of successfully innovative firms of this type. The SOE case we examined in detail, however, was CNEGC, a central SOE belonging to a third SOE category, *socialist*. This seems the most dynamic of the three SOE types, with most scope for worker initiative—and ample funding. And although broadly CNEGC was operating within a compartmentalized business system, its close relationships with central SOE customers appeared to give some alliance coordination. It is not surprising, then, that it scored the only clear-cut success among the three cases, with its defensive strategy.

But socialist firms like this are few, and being mostly intended for military challenges, are few indeed in civil sectors like steel plant. For the same reason



CNEGC's situation is precarious: it could at any point be subjected to the bureaucratic governance—and arbitrary interference—suffered by the large majority of central SOEs.

The argument thus far has been mainly qualitative: some firm types in China are in some important sense innovative, capable of developing real independent 'indigenous' technological capability, and some are not. We have however ventured some quantitative statements—notably about the predominance of bureaucratic firms, operating mostly in cartellized systems, and of patriarchal/opportunist firms, in fragmented systems. We will venture another, about level of technology by sector: in low-technology sectors even patriarchal firms can perform quite competently, while as one looks at successively higher technology, the more one finds that deficiencies in training and in access to capital become handicaps to even paternalist or state-paternalist firms. It is notable that our three success stories, such as they are, belong to medium-high-technology sectors, in the OECD's terms. China has successful innovative firms in high-tech sectors too, but only a few. The large bulk of Chinese 'high-tech' exports belongs to the computer and telecoms sectors, with electronics a poor second and the rest far behind (Xing, 2012). As regards the trade balance, computers and telecoms are the only sector with a significant positive balance: a large one. However, it shrinks by more than a third if one amalgamates this sector with electronics: clearly what is happening is the import of core components on a massive scale, to be assembled into final goods, 'Made In China'.

If this assembly were being done by Chinese firms with their own IP, it would still be impressive: 'systems integration' is a valuable competence. In telecoms capital equipment just that (and some core component manufacture) is being done successfully by Huawei and ZTE, but this is untypical: two thirds of high-tech exports are produced by wholly-owned subsidiaries of foreign firms (Xing, 2012). Nearly half the rest is produced by joint ventures. And of the independent Chinese firms, there are many cases like that of Changhong, the TV maker analysed by Xiao et al. (2013), which are utterly dependent on foreign IP for which they pay royalties that cut their own profits to the bone.

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